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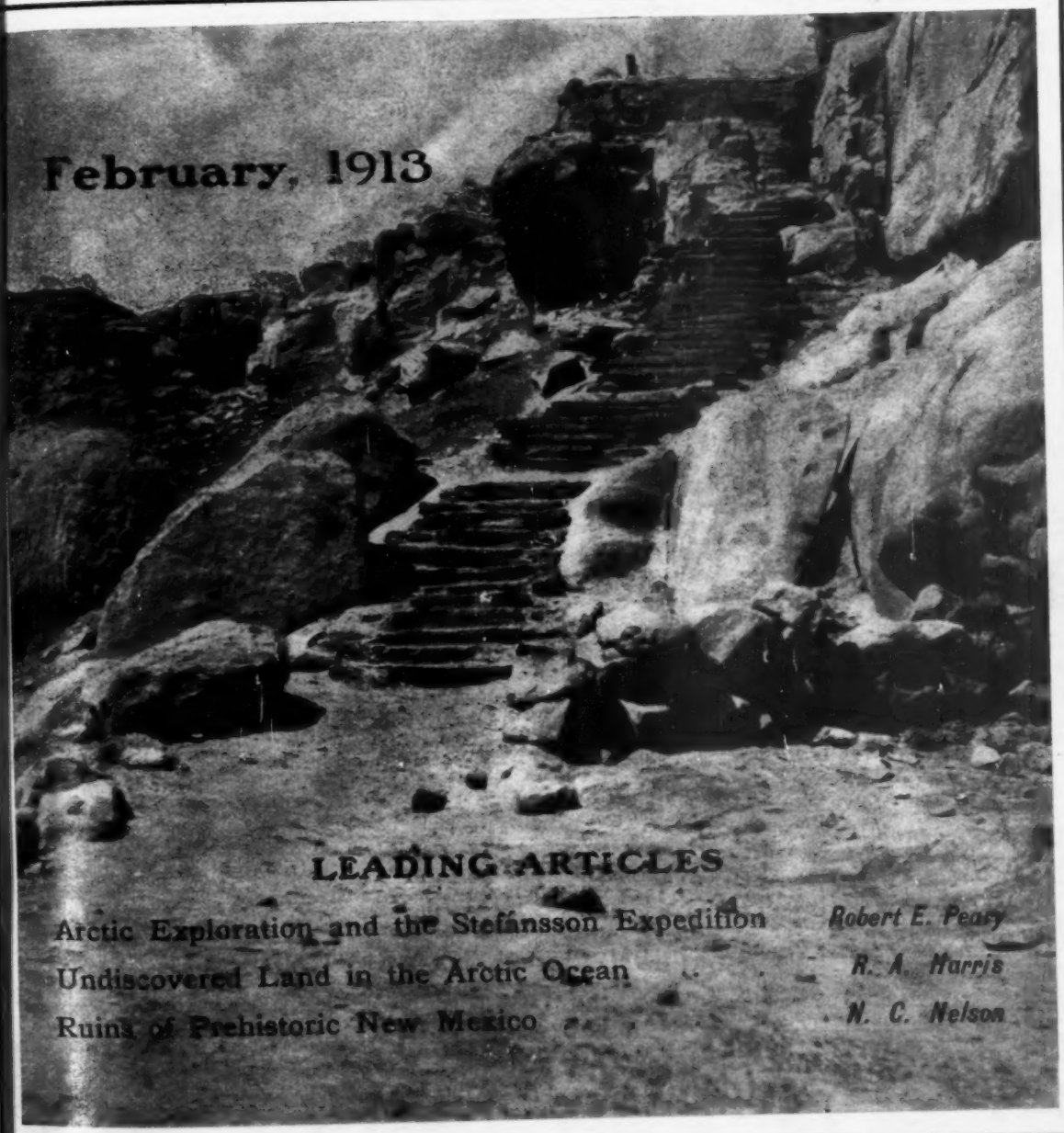

February, 1913

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The American Museum Journal

VOLUME XIII FEBRUARY, 1913 NUMBER 2

CONTENTS

Cover, Ancient Stairway at Pueblo Shipaulovi, photographed by Herbert J. Spinden.

Frontispiece, Photograph of the New Wharf-Pile Group in the American Museum

Polar Exploration and the New Stefánsson Expedition
ROBERT E. PEARY 51

Plans of the Stefánsson Expedition. . . . . CLARK WISSLER 55
Liberal support by the Canadian Government — Work geographical and anthropological
Map of proposed route of the expedition; unknown area awaiting exploration. Map prepared under Vilhjálmur Stefánsson

Undiscovered Land in the Arctic Ocean. . . . . R. A. HARRIS 57
Proof from the behavior of tides of the existence of an uncharted Arctic continent of perhaps 500,000 square miles, or of an archipelago of large islands
Map of polar regions indicating theoretical position, size and shape of undiscovered land; also ranges and directions of tides constituting proof. Map prepared under R. A. Harris

Ruins of Prehistoric New Mexico. . . . . N. C. NELSON 63
Extensive excavations of pueblos in the Rio Grande Valley for data to explain the origin and present day distribution and cultures of the people of the Southwest. Map of Rio Grande drainage to show archæological sites located by the Nelson expedition. Map prepared under N. C. Nelson

Indians of the Southwest. 83
Announcement of special display of collections opened at the Museum February 27 and of an exhibition of paintings including canvases by the late Louis Akin
Announcement illustrated with photographs from the new Navajo group

Animals of the Wharf Piles. . . . . ROY W. MINER 87
Description of a new group from the standpoint of animal specialization to inactive life

The Wharf-Pile Group. 91
Editorial comment and notes on the construction of the group

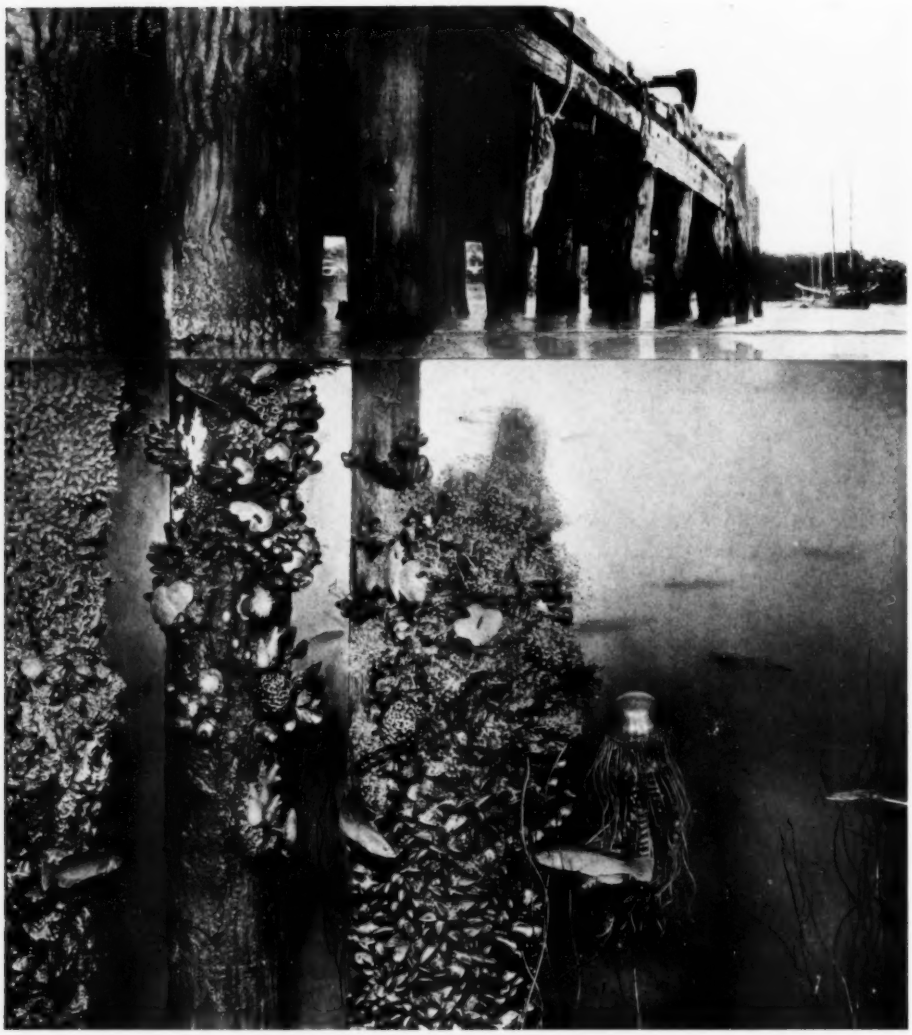
Museum Notes. 93

MARY CYNTHIA DICKERSON, *Editor*

Published monthly from October to May by the American Museum of Natural History. Terms: one dollar per year, fifteen cents per copy. Entered as second-class matter January 12, 1907, at the Post-Office at Boston, Mass., Act of Congress, July 16, 1894.

Subscriptions should be addressed to the AMERICAN MUSEUM JOURNAL, 77th St. and Central Park West, New York City.

The Journal is sent free to all members of the Museum.



A NEW MARINE GROUP SHOWING THE ANIMAL LIFE OF WHARF FILES

The old abandoned wharf, part of which is represented by a photographic transparency forming the background, is located at Vineyard Haven, Massachusetts, the cottages of which may be seen between the piles in the distance. In the foreground, the sea is represented as if in section to disclose the numerous sponges, hydroids, sea anemones, shellfish, ascidians and other sedentary animals with which the piles are crowded below the low water mark

—" Animals of the Wharf Piles," page 87

The American Museum Journal

VOL. XIII FEBRUARY, 1913 No. 2

ARCTIC EXPLORATION AND THE NEW STEFÁNSSON EXPEDITION

By Robert E. Peary

IT becomes more and more an age of doing great things, of directing private, institutional and national wealth into channels for great results, and I am glad because of my keen interest in polar exploration, that some of the great things to be done are still to be found in the fastnesses of the Far North notwithstanding four centuries of interest and pioneer work.

Exploration has shifted decade by decade from one continent to another and from the Arctic to the Antarctic. The search for the North Pole was carried on many years before that for the South Pole began. Now both Poles have been attained, together with a large body of scientific fact, geographical and otherwise, brought back by the various exploring parties. The globe about the two Poles has held its mystery guarded most sternly of all the regions of the earth, especially about the North Pole where there is no land and the explorer can proceed in winter and earliest spring only, making hazardous journeys on shifting ice over unfathomed ocean depths. With all that has been accomplished, many hundred thousands of square miles still remain of the three million square miles of uncharted territory that existed prior to the expedition that resulted in the discovery of the Pole. To complete this exploration, to replace with knowledge the tradition and

theory accrued during past years is the step immediately before us and cannot fail to be of great value to science.

Of unexplored regions in the North, there are remaining but two of first importance: the inland ice cap of Greenland and the area represented by the large blank space on the map bounded by Bering Strait and the Pole, the western border of the Arctic Archipelago and the known open sea north of Siberia. The theories of cotidal experts have it that within this region lies an undiscovered Arctic continent, or a series of large islands separated by narrow channels, the whole not greatly distant from Banks Island, Prince Patrick Island and Grant Land (the western limit of the Arctic Archipelago), while tradition among the Eskimo and indefinite reports of whalers

Reprinted from May Journal, 1912

The north polar regions have sternly guarded their unknown areas with shifting ice over deep sea. Cotidal experts now maintain the existence of a land mass, possibly of 500,000 square miles, in what is represented as open polar basin immediately north of British America and west of the Arctic Archipelago

strengthen the theories in fixing the southern edge of the unknown land not far north of Point Barrow and the northern shores of America. I must believe in the existence of such land, one corner of which I saw from Cape Thomas Hubbard in July, 1906, in the mountain peaks of Crocker Land.

If land of large extent be located west of Banks Island and Grant Land, the discovery from the standpoint of future exploration will be of unusual importance, since the new land will be a base for penetration of the remainder of the unknown area to the west. In fact, since the theory of the existence of extensive land, one corner of which is Crocker Land and another not far

from Banks Island, seems so likely to me and is so well accepted by many expert geographers and mathematicians, I would divide the remaining greatest problem in the North into two separate problems — namely, the exploration of this land area and the exploration of the adjoining area beyond, between the Pole and Bering Strait.

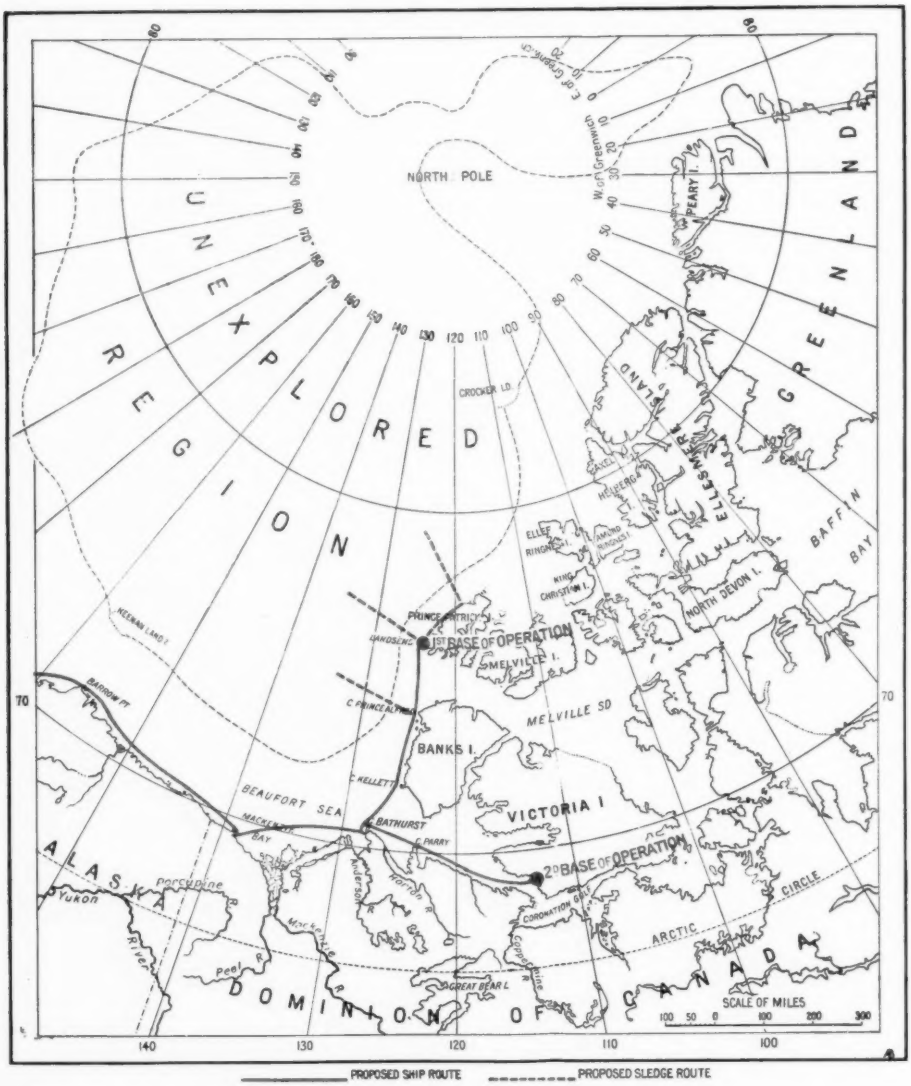
The eyes of the scientific world are on the projected expeditions which have for the geographical part of their work a search for this uncharted land. The Crocker Land expedition,[1] under the auspices of the American Geographical Society and the American Museum of Natural History, has been announced for more than a year, having had its activity deferred by the deplored death of George Borup, its prospective leader. An announcement is now definitely made that the Stefánsson expedition reported some months ago as likely to proceed on polar investigations under the auspices of the National Geographic Society and the American Museum of Natural History is to proceed with most liberal support as an expedition of the Canadian Government.

The Scott tragedy, which has made men's names imperishable and brought the heroic in human nature strongly to all people, has set an emphasis upon expeditions about to enter polar work. Mr. Stefánsson will carry not only a well-equipped expedition into the vastness and bleakness of the North, but also with it the thought and warm heart of the world left in the comforts and comradeship of civilization.

In personality and from training and experience, he is especially fitted for this work, his courage and control of untoward circumstances have been proved in the six years he has already put in on Arctic investigations, and he has shown executive ability and judgment in his plans for organization of the new expedition. I am glad that in addition he has some of the qualities of a dreamer. For the greater work of life requires the man to whom a vision can come with such allurement that he must follow its leading through all obstacles and many years, goaded always to express the irresistible power within him in the accomplishment of that vision. And when I recall that to these characteristics he adds the hardy qualities that come from his ancestry of the North and to these still again the authority of science from his training as an ethnologist, I can but congratulate the scientific world and the Canadian Government that Vilhjálmur Stefánsson has stepped forth to do a man's work in Arctic exploration.

As I said regarding the Crocker Land expedition, I would that my years were fewer that I also might penetrate again into the enchanted solitudes. I can hear the yelping of the dogs, the shouting of the drivers and forward rushing of the sledges, as after days of weary travel across the ragged sea ice, every man and dog spurts for the shore of that untrodden land lying a few yards ahead in the brilliant Arctic sunlight.

[1] See Peary on Crocker Land Expedition in AMERICAN MUSEUM JOURNAL for May, 1912 — EDITOR.



PROPOSED ROUTE OF THE STEFÁNSSON EXPEDITION

Map prepared under Vilhjálmur Stefánsson

Proposed sledge and ship routes and bases of operation of the Stefánsson expedition originally planned under the auspices of the National Geographic Society and American Museum of Natural History and finally transferred to the support of the Canadian Government. The expedition will sail in May from the Canadian naval station at Esquimault, British Columbia, with the recently purchased "Karluk," 247 tons, for exploration work covering a period of from three to four years

"Your base is one of the nearest, and perhaps the most accessible point for an attack upon the largest remaining unexplored areas within the Arctic Circle."— Quoted from a telegram from Peary to Stefánsson, November 16, 1912

PLANS OF THE STEFÁNSSON EXPEDITION

By Clark Wissler

A NEW expedition to carry on the work begun in part by the Stefánsson-Anderson expedition was projected some months ago in the interests of the Museum. Immediately on the return of Mr. Stefánsson from his four and a half years in the Arctic, plans were set in preparation in the Museum for this second expedition. The National Geographic Society of Washington initiated the subscription with a large sum for the geographic part of the work. This organization also agreed to coöperate with the Museum in whose behalf Mrs. Morris K. Jesup contributed half the funds required for the expedition. While arrangements were being made for the expedition to set out in May of this year the Canadian Government, which through its Geological Survey was a party to the original Stefánsson-Anderson expedition, made a proposition to take over the entire expedition and to provide a large fund for its support as well as to make it a governmental matter. While this is a great loss to the Museum, it is but fitting that such an important expedition into Canadian territory should be controlled by Canada.

I quote the following letters by the Prime Minister of Canada and the President of the American Museum:

NEW YORK CITY, *February* 12, 1913.

DEAR MR. STEFÁNSSON:

The offer of the Canadian Government, through the telegram of the Honorable William J. Roche, Minister of the Interior, on Monday, February 10, to cover the entire expenses of an expedition to the Arctic, places the plans you have made with us and with the National Geographic Society in a new light.

It would appear that this offers an opportunity of conducting your explorations under the direction of a strong government which, through patriotic as well as scientific motives, will take every possible step to insure success.

We feel bound, under these circumstances, to relinquish the claim which our prolonged preliminary negotiations and understanding may have given us upon your expedition. We desire you to conduct your negotiations, therefore, with the Canadian Government, with entire freedom.

It is, however, with the greatest reluctance that, through our desire to do what seems best for the general interests of science, we sever a connection established in 1908 with yourself and Dr. Anderson, which has been animated throughout by warm personal regard and which has been attended by the achievement of such notable scientific results. We desire especially to make record of our appreciation of the heroic and self-sacrificing efforts which you and Dr. Anderson made in carrying out the project of the first Stefánsson-Anderson expedition.

In case you enter upon this proposed service of the Canadian Government, I am sure that the entire Scientific Staff of the American Museum will unite with me in the expression of our heartiest goodwill and of our desire that you may successfully accomplish all the objects that you have in mind in the way of further exploration.

In view of our past friendly coöperation with the Canadian Survey, we trust that continued coöperation with this Museum, especially in certain lines of anthropology and zoölogy, may be arranged for in connection with your expedition.

Believe me, with the highest regard,

Faithfully yours,

[Signed] HENRY FAIRFIELD OSBORN

President of the American Museum of Natural History

PRIME MINISTER'S OFFICE, CANADA

OTTAWA, ONTARIO, *February* 21, 1913

DEAR SIR:

Mr. Stefánsson has shown me your letter of the 12th instant stating that you are willing to forego your claims to a share in his exploration of the northern waters of Canada, and to cancel the arrangements which you had so generously made to contribute towards the expenses of this undertaking, and I wish to thank you for your courtesy in withdrawing in favor of this Government.

We are most appreciative of the valuable results obtained by Mr. Stefánsson's explorations in the northern part of the American continent, which have given valuable information as to this comparatively unknown portion of the Dominion of Canada, and have to thank you for the part you took in assisting Mr. Stefánsson in that work. The Government of Canada feels however, with regard to the present exploration, that it would be more suitable if the expenses are borne by the Government more immediately interested, and if the expedition sails under the flag of the country which is to be explored. The Government is, however, desirous that the line of investigation begun by Mr. Stefánsson and the members of your Association should be continued and would be glad of the scientific coöperation of your members so as to obtain the best results from this expedition.

Yours very truly,

[Signed] R. L. BORDEN

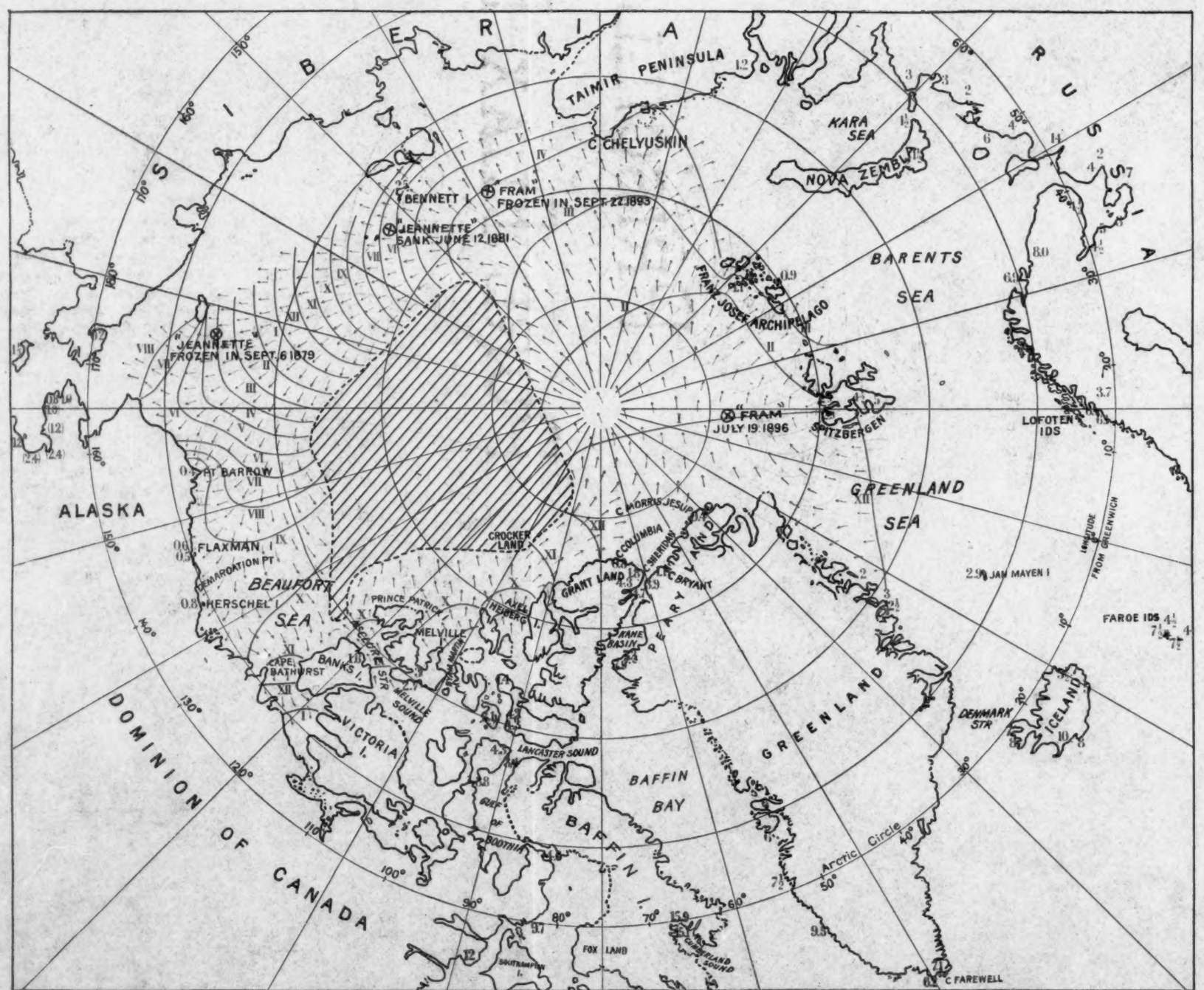
It is Mr. Stefánsson's present intention to carry out in detail the plan as formerly developed in the interests of this Museum and the National Geographic Society. Its chief aim will be geographical and anthropological exploration. As planned, the expedition will have two main bases, the northern one on Prince Patrick Island and the southern on the mainland of North America near Coronation Gulf. Mr. Stefánsson will give personal attention to geographical exploration and the study of the Eskimo, Dr. Anderson will conduct the biological investigations. It is expected that a staff of at least six scientists will accompany Mr. Stefánsson, Dr. Anderson being one of that number.

In general, the plan is to spend three or four years in an intensive study of the archæology and ethnology of the Eskimo, together with the zoölogy and geology of the whole region from Alaska to Coronation Gulf. Also, to map the unexplored coast of Victoria and Prince Patrick islands and by offshore journeys to the north and east determine by means of soundings the extent of the continental shelf and discover new lands, if such there be. It is intended that the expedition shall be a scientific one and devote its energies to the investigation of this unknown region.

The anthropological work is to be made a special feature, the main problem here being to determine the present and former limits of human occupation. During summer the surface will be searched for traces of former villages which when found will be carefully studied by excavation and otherwise to determine their relative ages and the cultural character of their occupants. Such archæological work is now needed to estimate the period of occupation and the direction of Eskimo migration.

In the east, special attention will be given to the distribution of the peculiar hybrid Eskimo discovered on the last expedition. It is intended that a full census of the people be made, noting the somatic character of each to serve as a basis for the study of this peculiar biological problem.

BARENTS
SEA
GREENLAND
ICELAND



OUTLINE MAP OF ARCTIC REGIONS

Prepared under direction of R. A. Harris, cotidal mathematician of the United States Coast and Geodetic Survey

The map indicates the theoretical position, size (500,000 square miles) and shape of an uncharted Arctic continent, or archipelago of large islands. It shows also the directions and hours of the tides and the rise in feet and tenths — which tidal facts constitute a proof of the existence of the unknown land

UNDISCOVERED LAND IN THE ARCTIC OCEAN[1]

By R. A. Harris

Of the United States Coast and Geodetic Survey

FROM the behavior of the tides, it can be shown that a deep Arctic basin cannot extend without interruption from the region of deep waters traversed by the "Fram" and embracing the Pole itself, to the known waters lying along the Arctic coasts of British America, Alaska and eastern Siberia. Moreover, this interruption lying between the Arctic Archipelago and the New Siberian Islands must be tolerably complete so far as the greater depths are concerned. For were this not the case, the Arctic basin would be well suited to the production of diurnal or daily tides, which would be much in evidence along the coasts just mentioned. Wherever adequate observations have been made along these coasts, they show that the diurnal tides have less than one-half of the rise and fall which the diurnal tidal forces of the moon and sun acting over the uninterrupted Arctic basin would produce; and again, the diurnal tide actually occurs earlier at Point Barrow than at Flaxman Island while the tidal forces acting over the uninterrupted basin require that the reverse should be the case.

The ratio of the amplitudes of the two principal constituents of the diurnal tide or wave does not have even approximately its theoretical value, a fact which implies for this tide a comparatively complicated origin.[2] It may be noted in passing that it is because the free period of a deep Arctic basin is but a fraction of twenty-four hours in duration that we are enabled to say that approximately equilibrium tides would be the result of the action of the diurnal forces. Moreover these same conditions would reduce the effect of the deflecting force of the earth's rotation to a quantity rather small in comparison with the direct effect of the tide-producing forces, not-

[1] The substance of this article is, in a large measure, included in previous articles by the Author upon the same subject, to which the following are references:

National Geographic Magazine, Vol. 15 (1904), pp. 255–261;

Coast and Geodetic Survey Report, 1904, pp. 381–389;

Report of the Eighth International Geographic Congress, 1904, pp. 397–406;

The North Pole by R. E. Peary. New York: Stokes, 1910, pp. 337–346;

Arctic Tides; a special publication by the U. S. Coast and Geodetic Survey, 1911, pp. 103. *Arctic Tides* consists of a detailed study of the tides north of the 60th parallel; it includes a cotidal chart of the Arctic regions, upon which is a hypothetical outline of the obstructing mass of land. This is the outline or hypothetical boundary which appears upon the less detailed map accompanying the present article. In the light of more recent observations and discoveries, some of the data used and conclusions reached in the three articles published in 1904 have turned out to be erroneous, as can be seen upon comparison with the later articles. No attempt is here made to go into the history of the question of undiscovered land in the Arctic. References to some of the writings of individuals who prior to 1904 had expressed their views upon this subject are given in the three articles just referred to.

[2] The intensities of the two constituent diurnal forces are, at the Pole, 0.00000004466 g and 0.00000003175 g, respectively, g being the intensity of the force of gravity. These numerical coefficients multiplied by the distance of a point from the center of gravity of the surface of a deep basin, give the respective amplitudes of the two constituents of the diurnal tide

withstanding the fact that the effect in question becomes a maximum at the Pole.

At Bennett Island and at Teplitz Bay, Franz Josef Land, the range of the diurnal wave has about one-half of the magnitude which the tidal forces acting over an uninterrupted Arctic basin would produce.

The semidaily tides found in the Arctic Ocean are derived almost entirely from those of the North Atlantic, because the semidaily forces vanish at the Pole and are very small in the higher latitudes. These tides enter the Arctic Ocean proper by way of the strait lying between Spitzbergen and the eastern coast of northern Greenland. They are propagated through the Arctic to the New Siberian Islands, the average rise and fall at Bennett Island being 2.5 feet.[1] Now upon the assumption of an uninterrupted Arctic basin, the tides at Point Barrow and at Flaxman Island could not differ greatly in size from the tides which would, upon the same assumption, be found at Bennett Island. But as a matter of fact the rise and fall of the semidaily tide is 0.4 foot at Point Barrow and 0.5 foot at Flaxman Island. The rise and fall of the semidaily tides at Pitlekaj, a short distance northwest of Bering Strait, is 0.2 foot.

The time of the semidaily tide along the northern coast of Alaska does not agree with the time implied in the transmission of the tide wave from the Greenland Sea through an uninterrupted polar basin having such depths as those discovered by Nansen.

It being thus established that an obstruction in the Arctic Ocean exists which seriously interferes with the production of the diurnal tides in its waters, and moreover causes wide discrepancies between the amount of rise and fall of the semidaily tide at Bennett Island and that found along the northern coast of Alaska, the next questions relate to its size and disposition.

That one corner lies northerly from Bennett Island and is separated from

[1] SUGGESTION CONCERNING TIDAL OBSERVATIONS.— The reading of hourly or half-hourly heights upon a vertical fixed staff, even if for a period no longer than one, two or three days would, in many instances, be of great interest. To judge of the diurnal tide, the time selected should be at or near the time of the moon's farthest north or south. It requires a series of fifteen or thirty days for bringing out the principal tidal constituents. If fluctuations in the daily level are to be ascertained, the longer the series the better.

With the exception of Bennett Island and Pitlekaj, there is at present little or no tidal information available along the Arctic coast of Siberia, or upon the off-lying islands, from Taimir Peninsula to Bering Strait, although the Russian government has recently made tidal observations at Taimir Bay and on one of the New Siberian Islands. Aside from this extended coast line and off-lying islands, where observations would of course be of great value, the localities where information is especially wanted in this connection are: the northwestern coast of Alaska about midway between Point Hope and Point Barrow, Mackenzie Delta (outer coast), Cape Bathurst, west coast of Banks Island, western end of McClure Strait, Prince Patrick Island, Cape Isaachsen, western coast of Axel Heiberg Island, Cape Thomas Hubbard, and northwestern coast of Grant Land.

From *Arctic Tides* already referred to, it can be seen what localities are either wanting or are especially defective in reliable tidal data, and where, if data were secured, a service would be rendered in perfecting our knowledge of the tides. Such points and localities in the Arctic Archipelago are the following: Dolphin and Union Strait, Coronation Gulf, Prince of Wales Strait, Eureka Sound, Nansen Sound, Greely Fiord, McClintock Channel, northern side of Cumberland Peninsula, and the eastern shore of Fox Channel.

this island by a broad and presumably shallow strait can be inferred with considerable certainty from a comparison between the drifting of the "Jeannette," especially the later portion, and that of the "Fram." The "Jeannette" was frozen in at a point lying northeasterly from Wrangel Island and her general subsequent course lay approximately toward Cape Chelyuskin; the "Fram" was frozen in at a point to the northwestward of the New Siberian Islands, and her general subsequent course lay toward the Greenland Sea.

The change in the direction of the drifting ice seems to occur in about the longitude reached by the "Jeannette" when she sank. This indicates that one corner of the unknown land lies not very far to the northward of this point and so probably extends westward to about the meridian 150° E. With this strait and land mass assumed, it is easy to see that the semidaily tide transmitted through this strait will be greatly reduced in range upon entering the broad expanse of water to the eastward through a portion of which the "Jeannette" drifted. Hence the small range of the semidaily tides at Pitlekaj, Siberia, and at Point Barrow and other places along the northern and northwestern coast of Alaska. The strait and land mass can also account for the observed fact that the semidaily flood stream at Point Barrow comes from the west and not from the north as the absence of the land mass would imply, especially if the soundings or known depths around Point Barrow be taken into consideration.

An obstruction of the kind already established, probably implies that the land mass extends nearly continuously from the Bennett Island corner to within a short distance of the Arctic Archipelago.

The fact that the tide comes from the west at Point Barrow indicates the existence of a cape or corner of the unknown land lying to the northward of this point. But the fact that the tide is nearly simultaneous all along the northern coast of Alaska implies, not only that Beaufort Sea is a deep body of water, but also that this corner in question lies at a considerable distance from Point Barrow, say five or six degrees of latitude. Such a position of the cape or corner would permit the ice off the northern coast of Alaska to set west-northwest when driven by an easterly or east-northeasterly wind, as was noted on numerous occasions by Mikkelsen and Leffingwell in April and May, 1907, in longitudes varying from 148° to 151° W.

That there is a northern coast to Beaufort Sea in some such position as that shown in the diagram and extending from north of Point Barrow nearly to Banks Island, can be inferred from the following considerations:

1. The ice in Beaufort Sea does not drift freely to the northward, and is remarkable for its thickness and age. Northeasterly winds drive the ice westward. West of Banks Island large and old ice floes probably always extend down to the 72d parallel.

2. The observations just referred to indicate not only a considerable

westerly drifting when the wind is from an easterly direction, but also little or no movement of the ice when the wind is westerly. These circumstances, as far as they go, tend to show that Beaufort Sea is nearly landlocked in all directions excepting toward the west.

3. A description of the tide in Elson's Bay just east of Point Barrow, found upon p. 162, Vol. 42 (1854), of *Accounts and Papers, Navy,* reads as follows:

"The tides have been registered hourly for nine months, and the result is that the flood makes from the west, and the mean rise and fall in Elson's Bay is seven inches. The time of high water at full and change is 1 P. M., but great irregularities occur from the wind, the rise being scarcely perceptible with fresh east and northeast breezes, when with southwest gales it amounts to $3\frac{1}{2}$ feet. Of the latter case, a remarkable instance occurred on the 18th of December, when the water rose from the usual depth of $14\frac{1}{2}$ feet to 17 feet 10 inches, with a gale at southwest (true), the force of which was registered for fourteen hours at 8 feet, 9 inches and 10 feet."

Observations made at Ooglaamie just west of Point Barrow from February 26 to June 17, 1883, show that a west-southwest wind may, in extreme cases, cause the daily sea level to stand nearly three feet higher than when the wind is from the east-northeast. Observations taken on the south side of Flaxman Island in 1906, show that during the period extending from October 21 to December 17 the fluctuation in the daily sea level amounted to two feet, the lowest stage occurring at the time of northeasterly winds and the highest stage on westerly or southwesterly winds. Messrs. Leffingwell and Stefánsson have informed me that effects similar to these are common all along the northern coast of Alaska.

The natural inference from this is that the unknown coast line in question is not very remote from the northern coast line of Alaska and that the unknown land approaches the known Arctic Archipelago in one or more points, thus making a fairly complete land boundary to the north of Beaufort Sea.

4. There are large quantities of driftwood to the westward of the mouth of the Mackenzie River and a considerable amount for some distance to the eastward, although very little as far east as Coronation Gulf. This indicates a general westward movement of the ice in Beaufort Sea with occasional eastward movements when strong westerly winds prevail. Very little driftwood has been found on the islands to the northeastward of Banks Island or along the northern coasts of Grant Land and Greenland. This indicates that no drift ice of consequence goes from Beaufort Sea to the open ocean via the passage lying north of Prince Patrick Island, Axel Heiberg Island, Grant Land, and Greenland, and so the probability of a narrowing of the passage at one or more points. Were it not for prevailing easterly winds, the waters of the Mackenzie River should, because of the deflecting force of the earth's rotation, bear off to the eastward, instead of taking a more or less westerly direction.

5. It may be well here to call attention to the dividing line between the east-going and west-going drifts. Amongst the islands constituting the Arctic Archipelago, the general drift is easterly or southeasterly and here northwesterly winds prevail. Off the northern coast of Alaska the drift is westerly or somewhat to the north of west and the prevailing wind is from the east-northeast. It is probable, for reasons already given, that the prevailing drift on the Beaufort Sea proper is westerly. The eastern boundary of this sea appears to lie upon or near the dividing line between the east-going and west-going drifts. The proximity of one corner of the unknown land to either Banks Island or Prince Patrick Island would seem to harmonize with the approximate location of the divide.

Some of the facts which indicate the existence of a corner of the unknown land to the northwest of Grant Land are the following:

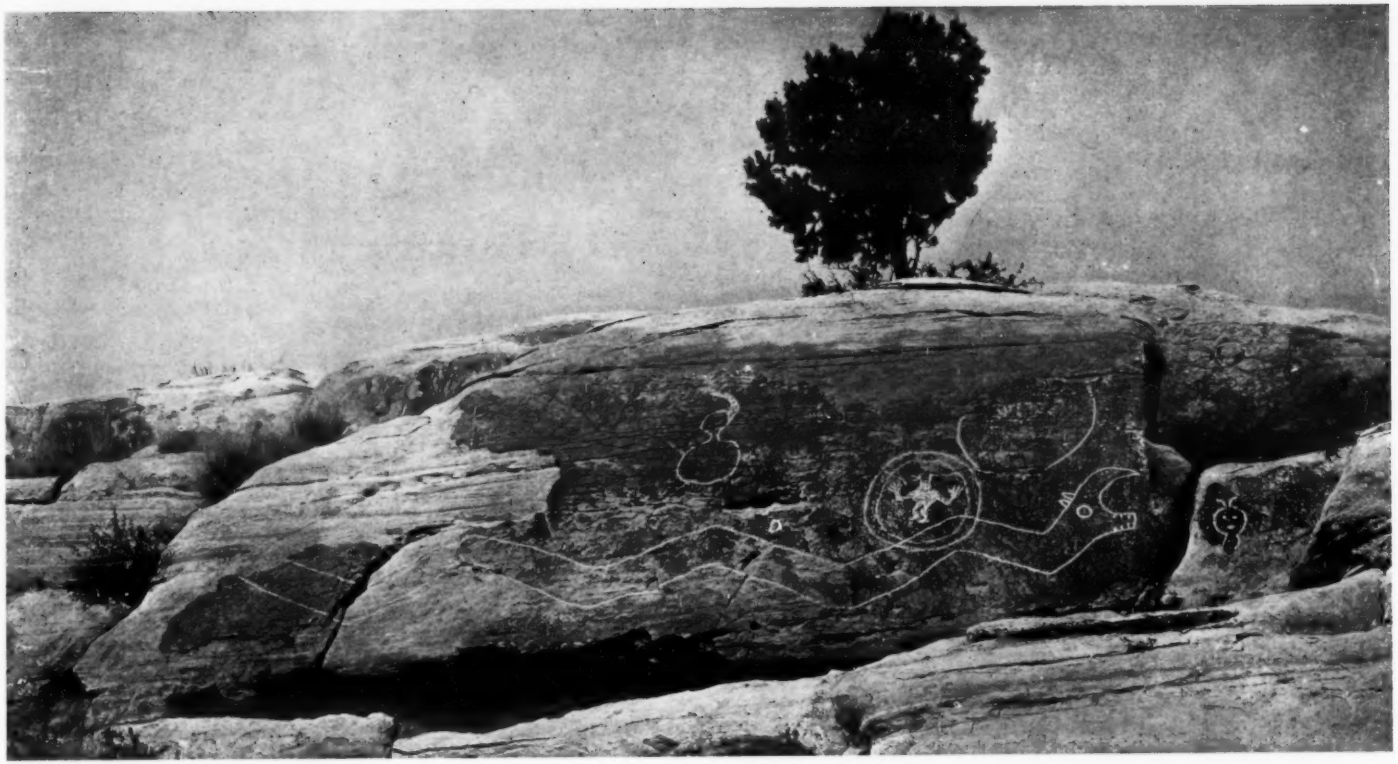
1. The sighting of Crocker Land by Peary, June 24, 1906, from an altitude of about two thousand feet.

2. The eastward progression of the semidaily tide along the northern coast of Grant Land, indicating that the tide derived from Lancaster and Jones Sounds, which progresses northerly through the channels to the westward of Axel Heiberg Island does not become exceedingly small when the northern coast of Grant Land is reached, as would probably be the case did not the unknown land approach Grant Land and so form the northern boundary of a channel of moderate width.

3. On his northward journey to the Pole, Peary found fox tracks a little below the 87th parallel and bear tracks just below latitude $86\frac{1}{2}°$. On his return march he found fox tracks somewhat north of the 87th parallel and bear tracks at latitude about $85\frac{1}{2}°$.

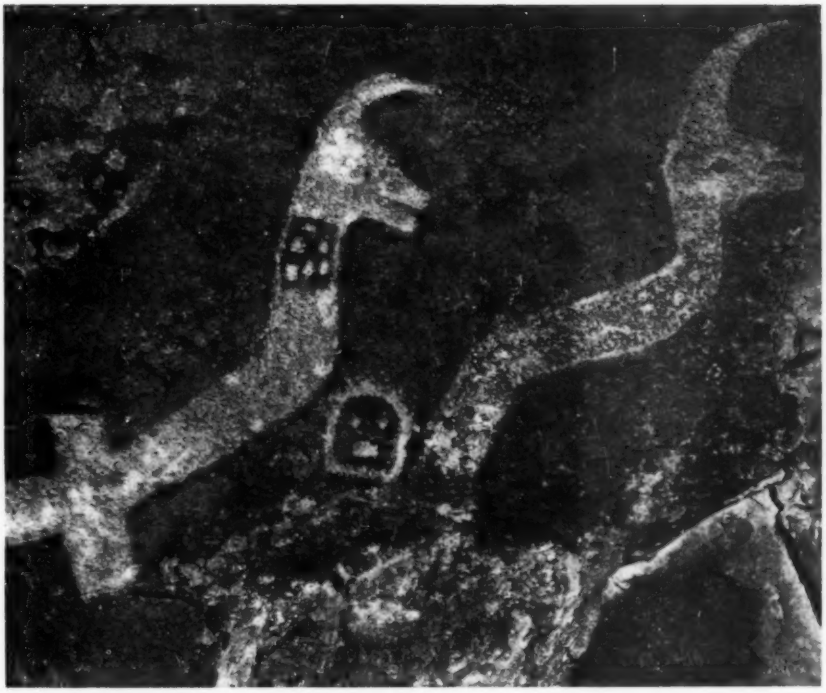
4. On the northward march of the Peary expedition, Marvin obtained in latitude 85° 23′ a sounding of 310 fathoms — a depth much less than was found at the two preceding sounding stations.

Assuming for reasons already given, the existence of a corner or cape lying northward from Bennett Island and similarly, of a corner lying northwestward from Grant Land, it is natural to suppose that a poleward, or European, side of this unknown land exists which connects in some fairly continuous manner the two corners just mentioned. The unexpectedly large range of tide at Bennett Island is a reason for drawing this boundary as near the Pole as known facts seem to permit; for in this way the tidal area between the unknown land and Europe is kept down as much as possible, thus helping to explain this unexpectedly large range of tide. It may be noted that the diurnal tidal forces acting upon the deep basin lying between this assumed boundary of the unknown land and Spitzbergen and Franz Josef Archipelago, give from theory a range and time of diurnal tide at Teplitz Bay very nearly equal to the range and time found from actual observation at that place.



PETROGLYPH OF A HORNED SERPENT

The original length of this rock picture of the horned serpent was not less than twenty-five feet. Snakes are still held in high regard by some of the Southwest Indians and in Hopi villages play an important part in the rain-producing ceremonies



Petroglyphs, or pictures chiseled on rock, representing mythical horned serpents, near Pueblo San Cristóbal

RUINS OF PREHISTORIC NEW MEXICO

EXTENSIVE EXCAVATIONS OF PUEBLOS IN THE RIO GRANDE VALLEY

By N. C. Nelson

AFTER the lapse of a decade the American Museum has once more begun archæological research in the Southwest. It is felt that many problems relating to the origin and distribution of peoples and to cultural traits now observable in the Southwest cannot be solved in their entirety by the examination of present-day conditions or even by consulting Spanish documentary history, which though it takes us back nearly four hundred years and is reasonably accurate, shows us little more than the last phase of development within this most interesting ethnographic division of the United States. By a tolerably exhaustive study of the thousands of ruins and other archæological features characteristic of the region, we may hope in time to gain not only an idea of prehistoric conditions but perhaps also an adequate explanation of the origin, the antiquity and the course of development leading up to a better understanding of the present status of aboriginal life in the region.

The field is very large and the work to be done so well-nigh momentous that no one institution will presume to accomplish it. Up to thirty years

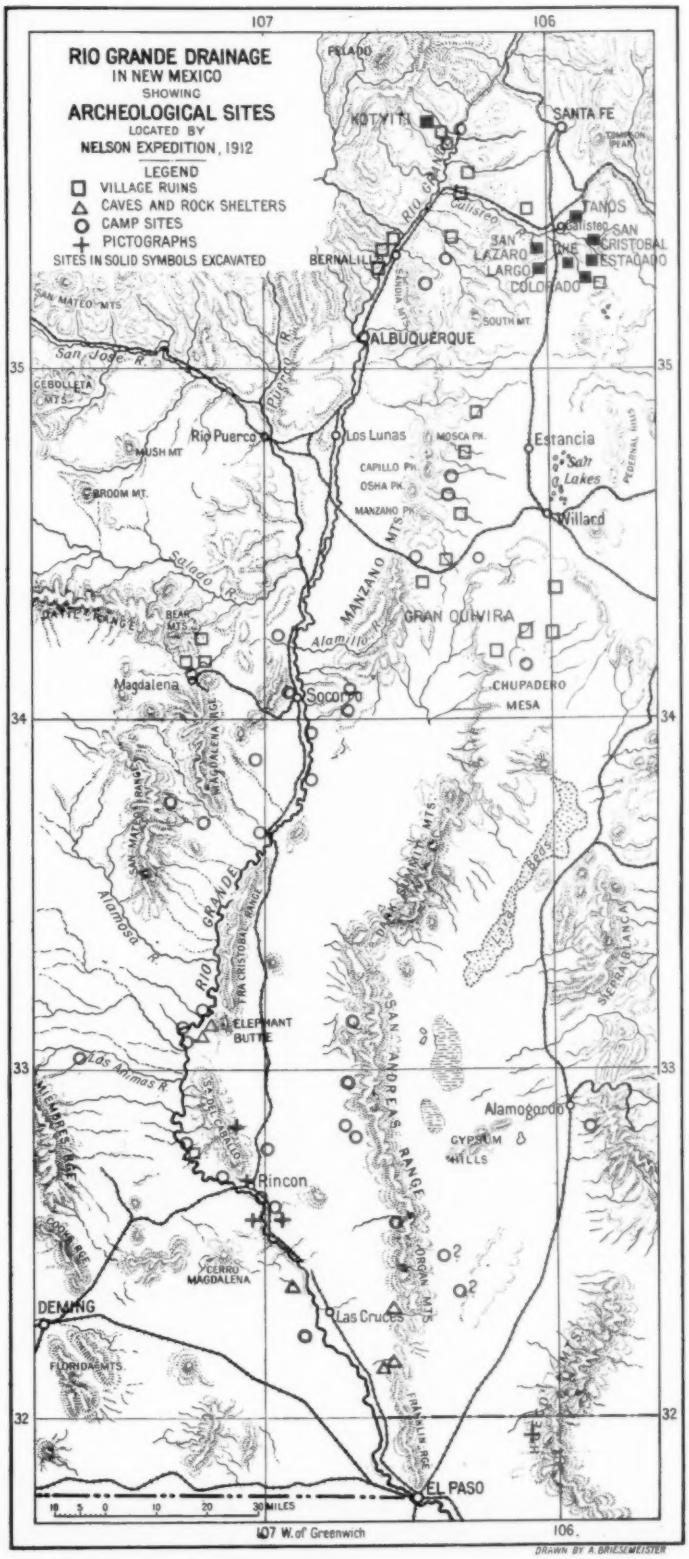
ago hardly anything was known about the archæological wealth of the region; and while since then many surveys and excavations have been made, there are still localities in which exist many ruins more or less well known, which have never been seen by any archæologist. One such locality is the Rio Grande drainage in the state of New Mexico or that part of the drainage ranging from the Jemez Mountains south to the Mexican boundary. It was to this area that the Museum's Southwest expedition gave its attention for six months of 1912.[1]

The field work began at Ysleta del Sur, a few miles below El Paso, Texas, and the advance was made up the valley chiefly by short railroad journeys. From most of the numerous stops, side trips east and west were taken on horseback or by wagon as conditions favored. Lack of time and the extremely swollen condition of the river impeded the work. Nevertheless at the end of five weeks when the Cochiti Cañon in the latitude of Santa Fé was reached, the location of one hundred and fifteen archæological sites had been ascertained, these comprising caves, rock-shelters, camp sites, mescal pits, cemeteries and petroglyphs as well as extensive ruins.

The region under consideration is eminently suited to have furthered the advance of a primitive culture in prehistoric times. The Rio Grande from the mouth of Santa Fé Creek where it emerges on its first considerable flood plain, takes a moderately sinuous course almost due south to El Paso. Throughout this three-hundred-mile stretch, the river receives numerous, mostly minor, tributaries, especially from the generally higher and more broken country which tends to crowd it along the west side. On the east there are only two or three affluents, all well to the north, the most important being Galisteo Creek. The dearth of tributary streams here is due to the fact that the mountain ranges paralleling the river are either very close to the stream as in the case of the Caballos and Sandia ranges, or are sepa-

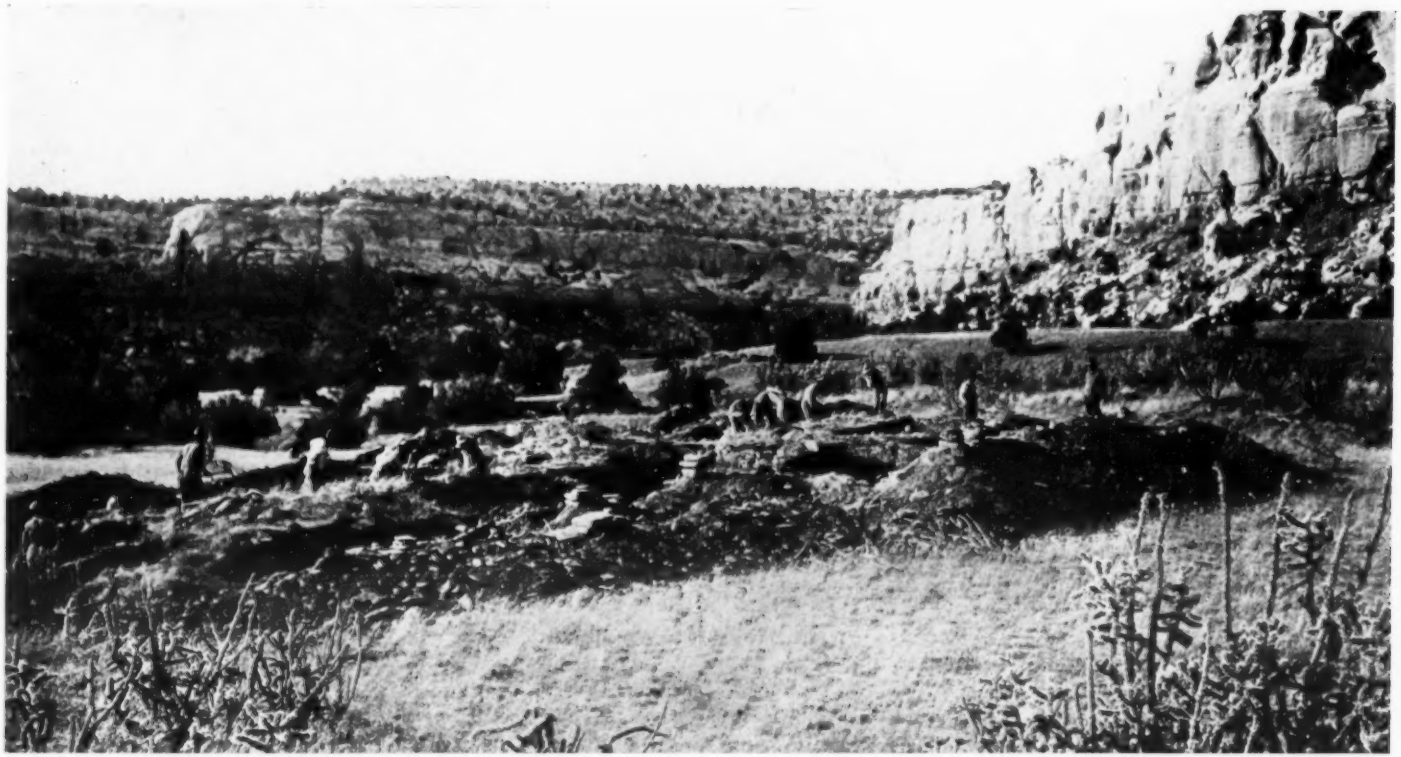
Beginning to clear the ruins of a two-story house of prehistoric date at Pueblo San Cristóbal

[1] Previous to the work in the Rio Grande valley, the expedition made brief visits to the well-known Casa Grande ruins near Phœnix, Arizona, and to Bisbee close to the Mexican boundary, where through the kindness of Mr. Cleveland H. Dodge, one of the trustees of the American Museum, some interesting petroglyphs were examined


RIO GRANDE DRAINAGE
IN NEW MEXICO
SHOWING
ARCHEOLOGICAL SITES
LOCATED BY
NELSON EXPEDITION, 1912
LEGEND
VILLAGE RUINS
CAVES AND ROCK SHELTERS
CAMP SITES
PICTOGRAPHS
SITES IN SOLID SYMBOLS EXCAVATED
107
106
35
34
33
32
PELADO
KOTYITI
SANTA FE
TRUCHAS PEAK
Rio Grande
Galisteo
TANOS
SAN CRISTOBAL
ESTANCIADO
SAN LAZARO
LAKE
LARGO
COLORADO
BERNALILLO
SAN MATEO MTS.
SOUTH MT.
ALBUQUERQUE
San Jose R.
Puerco R.
CEBOLLETA MTS.
Rio Puerco
MUSH MT.
BROOM MT.
Los Lunas
MOSCA PK.
CAPILLO PK.
OSHA PK.
MANZANO PK.
MANZANO MTS.
Estancia
Salt Lakes
PEDERNAL HILLS
Willard
Salado R.
BATTLE RANGE
BEAR MTS.
Alamillo
GRAN QUIVIRA
CHUPADERO MESA
Magdalena
Socorro
SAN MATEO MTS.
MAGDALENA RGE.
Alamosa R.
RIO GRANDE
FRA CRISTOBAL RANGE
DAY MOUNTAIN MTS.
LUNA BEDS
SIERRA BLANCA
ELEPHANT BUTTE
Las Animas R.
SAN ANDRES RANGE
Alamogordo
GYPSUM HILLS
Rincon
CERRO MAGDALENA
DEMING
Las Cruces
ORGAN MTS.
FLORIDA MTS.
FRANKLIN RGE.
EL PASO
30 20 10 0 10 20 30 MILES
107 W. of Greenwich
106
DRAWN BY A. BRIESEWEISTER

PUEBLO COLORADO RUINS

The cacti-covered mounds and ridges as seen from a nearby high cliff show the general arrangement of the village buildings, collapsed more than 350 years ago. In the large courtyard to the left is a circular reservoir which received its supply from the frequent thunder-showers peculiar to the region through a small dry gully beyond the view to the left



EXCAVATING A BUILDING AT PUEBLO COLORADO

This house, one of the smaller buildings of the pueblo, contained twenty-eight ground floor rooms in many of which were fireplaces and bins, pottery vessels, stones for grinding maize, and other objects of prehistoric culture. The maize-grinders may be observed piled up on the débris

rated from it by broad stretches of low semi-desert or barren plains, across which no living stream can reach.

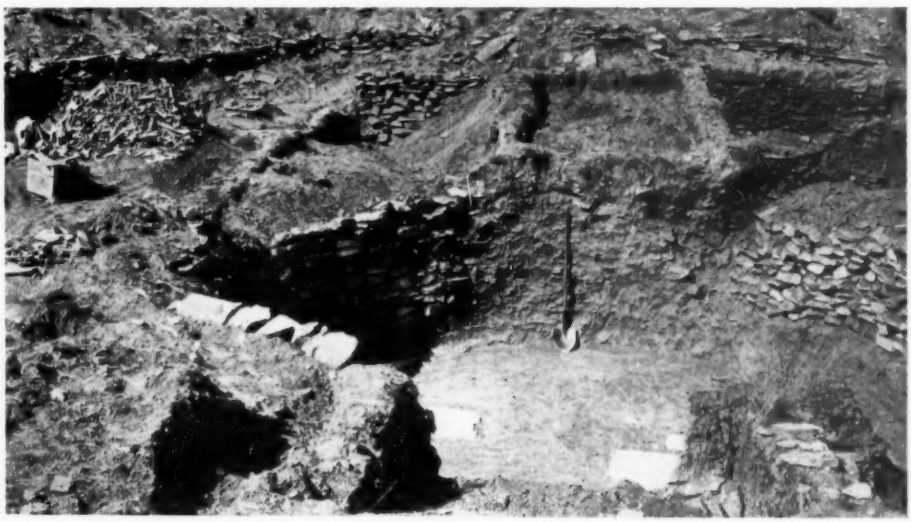
The river valley itself, or more properly its productive flood plain, varies in width from almost nothing up to four and five miles, according as the mountain ranges and occasional lava flows approach one another from opposite sides of the stream. This flood plain, subject in part to inundations, comprises close to 400,000 acres and is all of it suitable for irrigation. It was doubtless this fact which made the Rio Grande valley relatively populous in prehistoric times. Our first definite knowledge of its inhabitants dates back to the year 1540 when the Coronado expedition reported the existence of about seventy pueblos or villages in the valley. At the present day only seventeen villages of the old type remain in the entire Rio Grande drainage, and several of these such as Santo Domingo as well as additional scattered settlements near Las Cruces and at Ysleta del Sur, are of modern origin. From these facts it will readily be seen how rich the region must be in archæological data.

Ceiling and roof construction at Pueblo San Cristóbal. Over the timbers was placed a thicker layer of adobe sufficient to shed the rains

Small bin for foodstuffs, built of stone slabs in the corner of a room, at Pueblo San Cristóbal

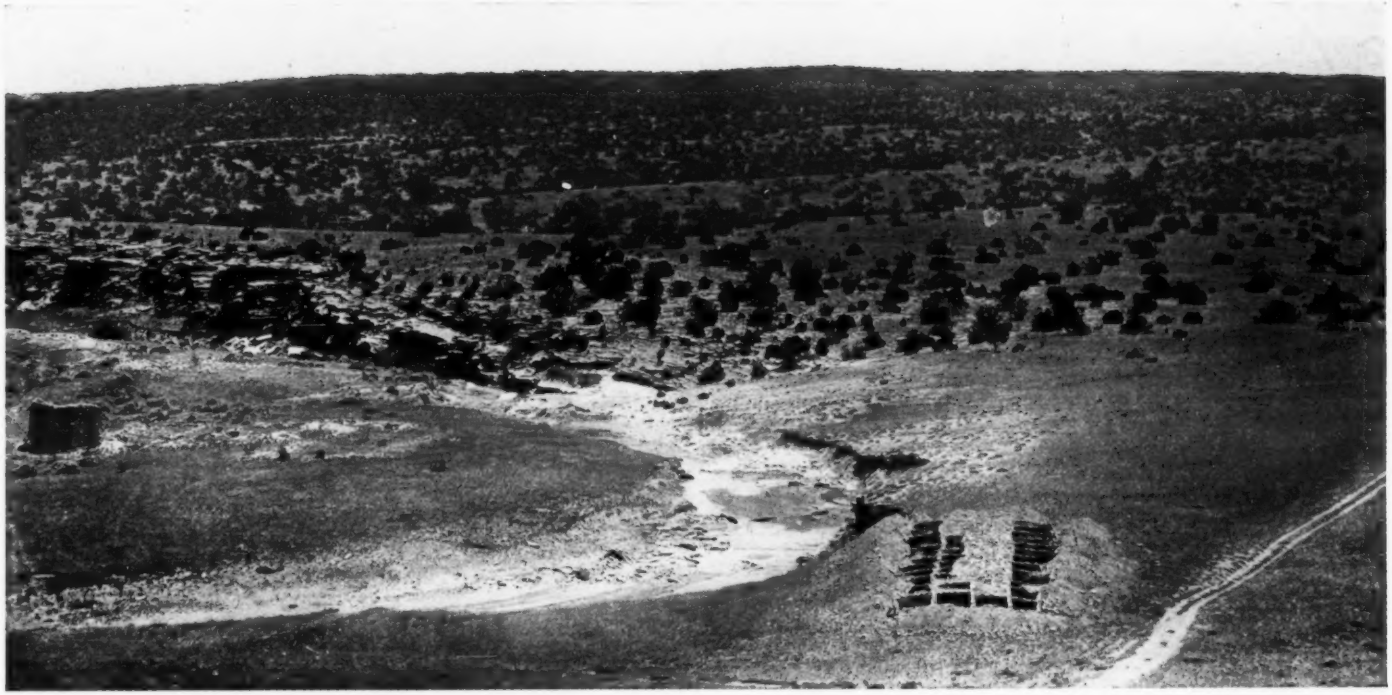
Most of the ruins located by the expedition however are not situated on the great river or the lands described as most suitable for cultivation but to the east and the west thirty or forty miles away. It is conceded that the Museum expedition did not examine all the ruins known to exist close to the Rio Grande; but if that had

Pottery found at Pueblo San Cristóbal. The ware is mostly of prehistoric make and includes bowls and small jars, some having painted and some glazed decoration



Circular kiva excavated at Pueblo San Cristóbal. This ceremonial chamber, twenty feet in diameter, was built into one of the regular long houses. The stones in the floor were possibly rests for ceiling props

Pottery vessels found at Pueblo San Cristóbal. The specimens are from a building inhabited during historic times and differ somewhat from the ancient ware in the nature of the glazed ornamentation



RUIN OF PREHISTORIC BUILDING OF SEVENTY-TWO ROOMS

The portions of the walls remaining in this ruin rise only from two to five feet above their foundation which corresponds to the general ground level. In process of excavation. Church ruin on the extreme left

Men at work clearing the rooms surrounding a kiva in a historic building at Pueblo San Cristóbal.

been done, the number would still have fallen far short of seventy, the total given by Coronado as inhabited in 1540. Doubtless Coronado's list included some of the villages located on the tributary streams such as Galisteo Creek, but there is still a margin to be accounted for and one is forced to believe that during the intervening centuries many village sites have been washed away or by some process obliterated. Such obliteration may explain also the apparent absence of village ruins at the southern end, that is, in the great Mesilla section of the valley, although we have here no less than 180,000 acres of bottom land suitable for cultivation.

As for the presence of immense ruins distant from the rich bottom lands, the fact is not easily explained. It may be stated however that, contrary to the prevailing notion about the great heat and dryness of New Mexican climate, dry farming is possible in the region say from Gran Quivira northward. Besides it is conceivable that these distant villagers did cultivate lands on the river bottom.

Human skeleton, apparently that of a woman who had been left lying in the corner of the room in the position in which she died

Up to the present time very little excavation had been done in the mapped area although immediately to the north in the more rugged and picturesque Pajarito Park district, important work has been carried on for some years by the School of American Archæology located at Santa Fé. It was partly with a view to profit by the presence of comparative culture material from an adjacent locality that the Museum excavations were begun at the northern extremity of the region under consideration. Here the ruins

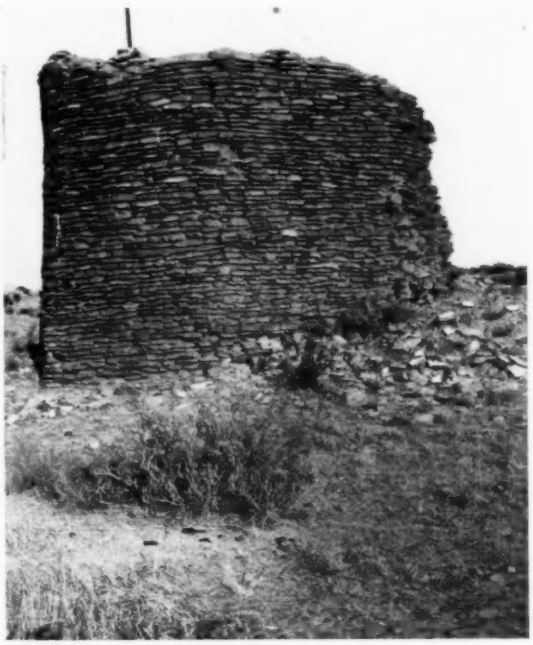
Petroglyphs near Pueblo San Cristóbal. Deer, snakes and other animals are represented

are also more thickly scattered than farther to the south, and climatic as well as other material conditions made it altogether the most suitable region in which to make a beginning.

The specific locality chosen was a large barren depression about twenty-five miles south of Santa Fé and the gathering place for the several streams which make up Galisteo Creek, an affluent of the Rio Grande some thirty

miles to the northwest. The excavated ruins, such as Tanos and San Cristóbal, are situated on these tributary streams and are arranged in such a way as to enclose a roughly oval stretch of territory about eight or ten miles in diameter — the Galisteo Basin. The ruins normally do not lie in the open basin, but immediately beyond its borders, a short distance up the cañons, penetrating the surrounding mesas and low-timbered hills. Various common sense reasons for the choice of site are usually apparent, such as shelter, the presence of building material, timber and water. Doubtless the element of defence against marauding enemies played a part although it is not clearly apparent in some cases.[1]

The Galisteo pueblos resemble those observed elsewhere in the Rio Grande drainage. They represent villages of the well-known communistic type, consisting of a series of buildings arranged at right angles in such a way as to form one or more enclosed courts or plazas. Within these enclosures are usually found traces of a circular and semi-subterranean structure, known as a kiva or estufa, and in fact a sort of underground house used in part for ceremonial purposes to the present day by the remaining Pueblo Indians along the Rio Grande. The ruins are those of large towns covering an area from three to ten acres in extent and appearing to-day in the form of well-marked ridges representing collapsed two and three story houses, invariably covered with a heavy growth of cacti. Close to the ruins are usually found one or more refuse heaps made up of ashes, animal bones, lost and discarded as well as broken artifacts, and a large number of human burials. The sites are characterized moreover



Remains of Spanish mission church at Pueblo San Cristóbal. Built probably during the first half of the seventeenth century and abandoned in 1680

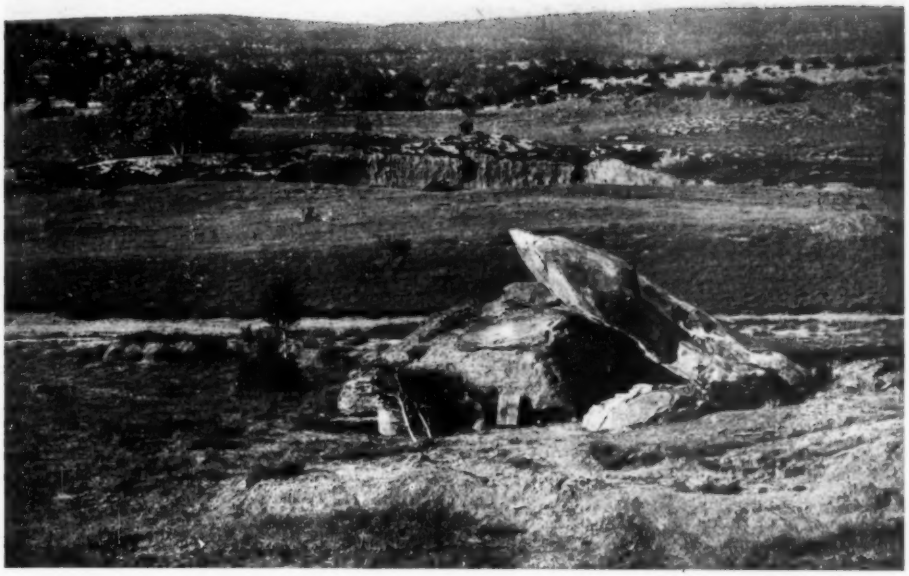
[1] It should be stated also that four of the excavated pueblos are located on the large estate of Mr. B. F. Pankey of Santa Fé, to whose generous treatment the expedition owes much.

by the presence of large artificial reservoirs sometimes at a considerable distance from the pueblo and sometimes, as is shown in one of the illustrations, directly within one of the courtyards of the village.

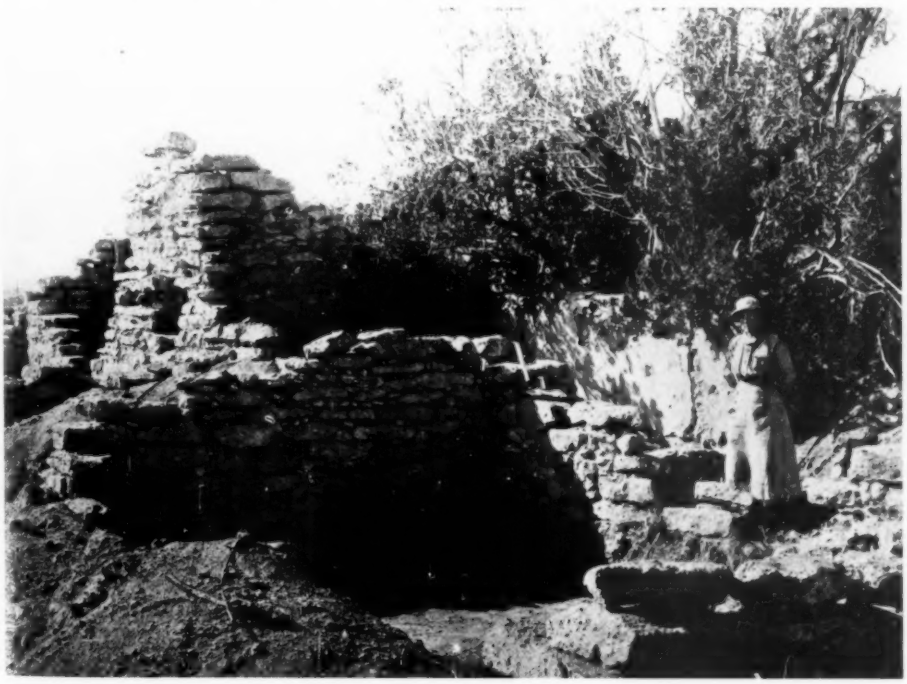
Still another feature of interest connected with each one of the pueblos is the presence of numerous petroglyphs or pictures chiseled on the nearby rocks. Some of the figures are purely geometric, others are conventionalized representations having no doubt a symbolic meaning and still others are unusually excellent delineations of the plant and animal life of the region. In a few instances scenes from the life of the people such as hunting and other pursuits have been depicted.

The excavation of the Galisteo pueblos occupied fully three months. Ten to fifteen laborers were constantly employed. No one of the ruined villages was completely bared, but enough excavation was done at each place to obtain a clear idea of the relative antiquity of the sites and their cultural relationships. Besides opening numerous scattered rooms, three entire buildings were cleared, the largest one, containing seventy-two rooms, being at San Cristóbal. Four of the seven ruins were found to be of prehistoric date, that is, they contained no evidence whatever of contact with European civilization.

The buildings range from about fifty to seven hundred feet in length and from thirty to forty-five feet in width. The walls, built usually of sandstone slabs and in a few instances of adobe blocks laid in mortar, still stand to a height of from two to nine feet, although as previously stated, they no doubt rose to a height of two and three stories, that is, about twenty feet. In some buildings the two or more stories rose on the terraced plan observable in several of the modern pueblos. The walls were plastered with mud and sometimes whitewashed. The floors were flagged with stone or were made of tamped clay, possibly mixed with blood, and showing often a very smooth and semi-polished surface. The ceiling, barely five and one-half feet above the floor level, was supported by heavy crossbeams overlaid by light timbers, brushwood and grass, on which was placed a layer of tamped clay to serve as floor for the story above. The rooms, usually rectangular or nearly so, averaged about seven by twelve feet in size, the larger dimension corresponding always to the long axis of the building, so that all the buildings of normal dimensions were from four to six rooms wide. From this fact it will readily be seen that whenever a building was of more than one story height, it contained a large number of interior and therefore dark rooms. These latter compartments were entered from the lighted exterior rooms by means of small rectangular doorways in the partition wall, usually a foot or two above the floor. The outer rooms themselves were presumably entered through an opening in the ceiling, as no doors were found in the walls leading directly to the courtyard. The arrangement of the different parts of the pueblo, as well as the regularity observed in the archi-



Rock-shelter at Pueblo San Cristóbal, formerly occupied by Indians (during a part of the field season by members of the expedition). The barren stretch between the cave and the timber line is a mass of ruins partly washed away and overgrown with grass



Best preserved portion of Pueblo Kotyiti which has stood in ruins for 220 years. Note the plaster still adhering to the walls

POTRERO VIEJO, AS SEEN FROM THE FRONT

On top of this natural fortress, a steep-sided mesa spur 500 feet high, the Indians of the region built a refugee village and made one of their last stands against the Spaniards

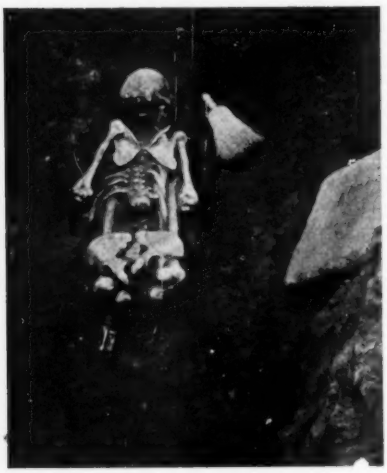
ONE OF THE RUINED BUILDINGS ON POTRERO VIEJO

This building of Pueblo Kotyiti was burned down by the Spaniards in 1693. About one hundred feet to the right of the building yawns the deep Cochiti Cañon at the bottom of which flows a small permanent stream, the only source of water supply for the mesa dwellers. After excavation of ruin

Fireplace at Pueblo Kotyiti. Across the upright stones was placed a smooth stone slab on which the cooking was done

tecture of individual buildings, suggests that the building plan was thought out before the construction work began.

Within the rooms were found such stationary household effects built of stone slabs, as fireplaces and bins for food stuffs. Also cages containing the bony remains of turkeys and eagles were found. Scattered on the floor and throughout the débris from the collapsed upper stories were numerous implements and utensils of bone, stone and shell, as well as pottery. Most of the specimens were used in the preparation of food and clothing, but things were present also suggestive of the less material side of life as for example, tobacco pipes, flutes, whistles, and ornamental objects of shell and turquoise. Smooth pebbles, quartz crystals, oddly shaped and curious rock formations, and even fossils were commonly met with and serve as testimony of ancient animistic beliefs. In one room was uncovered a small altar in the shape of a low platform. On it stood a human-like image of stone and



Human burial in refuse heap on which was later built a two or three story house. The body was tightly doubled up and laid face down

around this supposed god were laid numerous objects of the various types mentioned above.

The inhabitants of these villages or large groups of apartment houses, as they might be called, were agriculturists rather than hunters. Bones of

A shrine found in one of the rooms at Pueblo Largo. On a low earthen platform and leaning against the wall stands a stone image surrounded by various objects of bone, stone, and pottery. Photographed very nearly as found

the deer, the buffalo, and other animals were occasionally found in the prehistoric ruins; but it seems very clear that the meat diet was relatively light until the Spanish conquerors brought the domesticated animals of Europe. Remains of charred maize were found however, in every one of

RUIN OF A LONG HOUSE AT PUEBLO LARGO

This structure was originally built at a safe distance from the deep arroyo or gully passing through the village. After the site was abandoned and the neglected dams retaining the flow of water in the gully some distance above the village were broken through, the stream began to undercut its bank and at last reached the ruined building which is now more than half carried away

the ruins, so that although the cultivated fields can no longer be discerned, we may be reasonably certain that the inhabitants subsisted mainly by the cultivation of the soil.

Incidental to the expedition's main work in the Galisteo region, two weeks were given to the excavation of the historically famous ruin of Kotyiti on Potrero Viejo, a few miles west of the Rio Grande in the latitude of Santa Fé. Potrero Viejo is a high, steep-sided mesa spur, a strong natural fortress. It shows signs of having been occupied once in very ancient times, but Kotyiti itself was a village or temporary refuge built shortly after the Indian rebellion of 1680 to be destroyed by the reconquering Spaniards in 1693. Its excavation was undertaken partly to verify Spanish documentary history and partly also because it was possible to get here a glimpse of the conditions of pueblo life at a given and known instant of time. The entire ruin was cleared. It contained one hundred and thirty-six rather large living rooms and two estufas. The chief thing of interest learned from the excavation here was the fact that the Indians in the absence of the Spaniards made a fair success of smelting copper ore. This art was of course not of native origin but had been acquired in connection with Spanish mining operations.

Doorway connecting interior rooms at Pueblo San Cristóbal. This is the form of door in general use in all the pueblos of the region

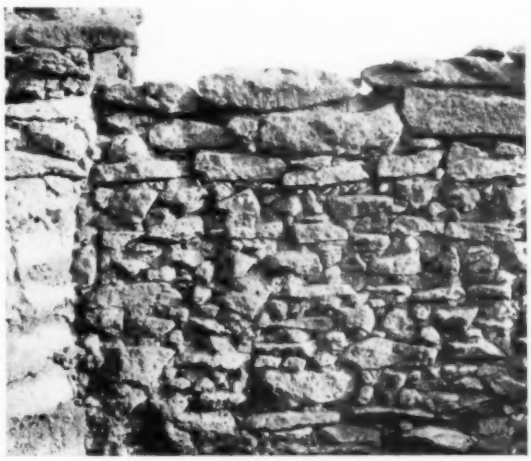


Illustration of the masonry at Pueblo Kotyiti. The larger blocks of stone were roughly dressed with stone tools and laid in mortar, after which the wall was chinked with small angular fragments, plastered and often whitewashed

FIGURE FROM THE NEW NAVAJO GROUP

Engaged in smoking a cigarette while he watches the women work. [The pipes of the Navajo tribe are used in ceremonies only.] This figure illustrates the manner of wearing the blankets made by the Navajo and shows the fringed buckskin leggings common until fifty years ago

INDIANS OF THE SOUTHWEST

SPECIAL EXHIBITION OPENED FEBRUARY 27 AT THE MUSEUM NAVAJO BLANKETS, PUEBLO POTTERY, PAINTINGS BY DISTINGUISHED ARTISTS, TO ILLUSTRATE THE LIFE OF INDIANS IN NEW MEXICO AND ARIZONA

FOR several years the Museum has been engaged in the study of the Indians of the Southwest in the course of which larger collections were made than can be exhibited at one time. The field work was provided for by Mr. Archer M. Huntington. In addition to the collections made under this grant, are shown the J. Pierpont Morgan Navajo textile collection and the Anson W. Hard collection of Mexican serapes. The permanent exhibit of material from the former Hyde expeditions is also on view. This exhibition will make it possible for those interested in the anthropology of the Southwest to study intensively the many characteristic phases of culture peculiar thereto.

Pounding one of the Mexican silver dollars from which Navajo jewelry is made. The silver-beater has on a velvet blouse and white cotton trousers, a costume much worn by Navajo men. The silver is shaped by pounding, then ornamented by stamping with steel dies. Finger rings, bracelets, necklaces and large oval disks for belts are the objects more commonly made for Navajo use

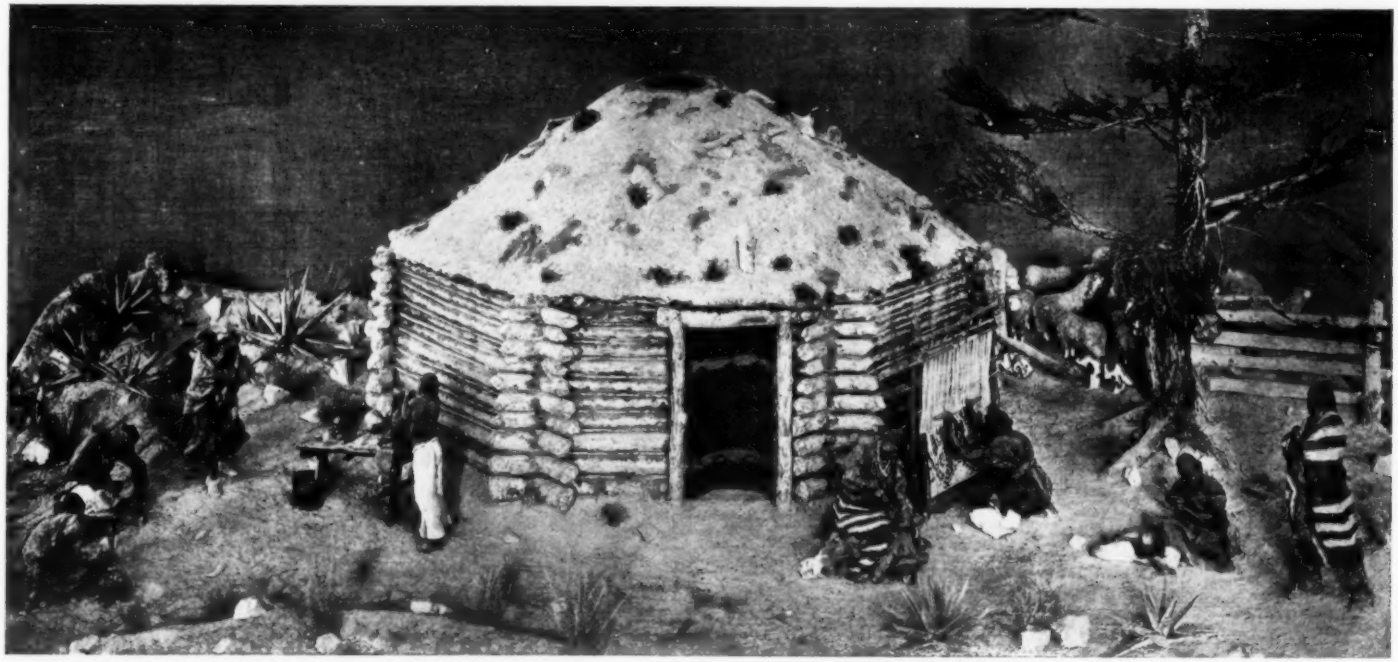
The Navajo girl is carrying in her shawl the baby brother too large for the cradle-board

There will also be on view a number of paintings by distinguished artists including some work by the late Louis Akin. This with photographs, sketches and maps will give one the feeling of the Southwest.

One of the special ethnic groups is here shown in the illustrations. Supplementary to this is a full-sized hogan or Navajo house, shipped to the Museum from the Navajo reservation. This is one of the older types of ceremonial hogan, built upon a foundation of four forked logs, the arrangement of which suggests the tipi pole structure among the Crow and some other tribes of Northern Plains Indians. In the near future it is proposed that the interior of this hogan be fitted out with the furnishings of a Navajo home and life-sized figures of the occupants.

A handbook on the Southwest has just been written by Dr. P. E. Goddard in which are discussed phases of Indian life peculiar to that part of our country. For a long time the Navajo and Pueblo Indians have excelled in decorated pottery and textiles. These arts are rather old because in many ancient ruins are fragments of very fine pottery. Also the early Spanish explorers found the people spinning and weaving cotton.

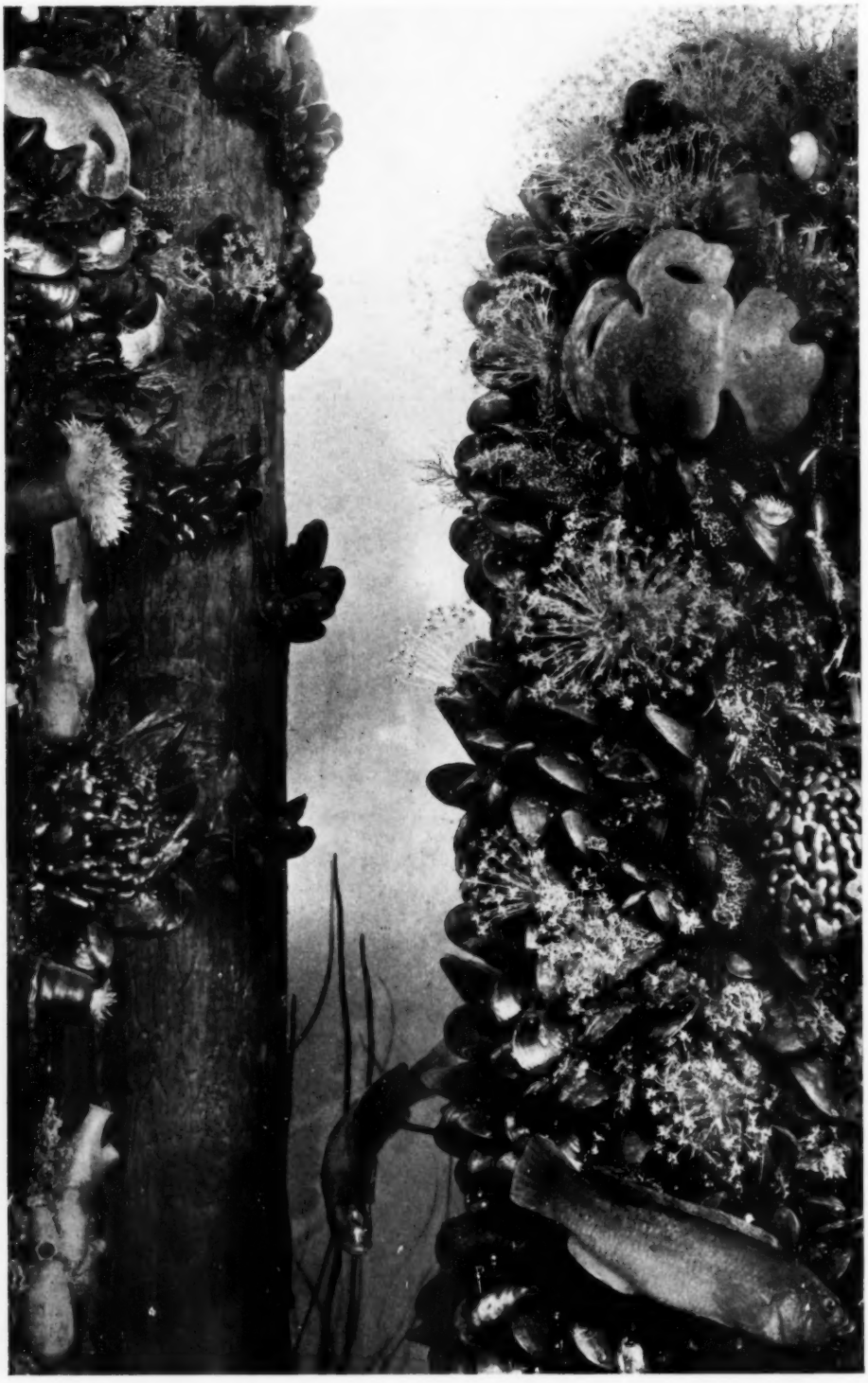
Navajo man making turquoise beads (drilling a piece of turquoise matrix with a bow drill)



A GROUP SHOWING NAVAJO HOME LIFE AND INDUSTRIES

Figures modeled by Misa Nessa Cohen, colored by Frederick H. Stoll. Accessories made and group assembled by Otto Block

The Navajo Indians of the Southwest have remade themselves since the Spaniards came into that country in 1540. They were a nomadic hunting people; they became a pastoral people. Nearly every family has a flock of sheep tended by the women and children. The increase of the flocks furnishes meat for home consumption. The wool is either sold through the trader or is made into blankets. Three parts of the process of blanket-making are illustrated on the right side of the Museum Navajo group. One woman is carding the wool into rolls, another is spinning the yarn, and a third is weaving a blanket on a simple loom. On the left of the group are men engaged in making ornaments of silver and turquoise and a boy is at the forge with bellows melting silver for casting



A DETAIL OF THE WHARF–PILE GROUP

The broken pile at the right is crowded with edible mussels, upon which are growing the feathery colonies of a beautiful pink-centered tubularian hydroid. The irregular lobed mass of the rose-colored ascidian ("sea pork") is seen on the upper part of the pile. On the pile at the left are shown sea anemones and various ascidians as well as colonies of the red-beard sponge

ANIMALS OF THE WHARF PILES

THE NEW VINEYARD HAVEN GROUP[1] AS AN ILLUSTRATION OF CERTAIN PHASES OF EVOLUTION

By Roy W. Miner

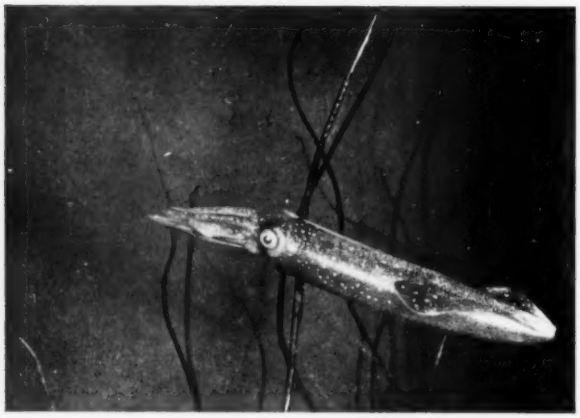
THE animal life which grows on the wharf piles furnishes a striking illustration of one of the important adaptive phases of the process of evolution — namely, specialization to an inactive life. In the new Vineyard Haven wharf-pile group, recently completed for one of the windows of the Darwin hall, an attempt has been made to emphasize this principle, as well as to depict the abundance and beauty of the animals themselves in their natural environment. The group illustrates a balanced association in which the struggle for existence between animals is not apparent, the majority of the species being plantlike and either incapable of locomotion in the adult stage, or in possession of it to a very limited degree.

On the broken pile in the center of the foreground, for example, growing over the mussels which have completely covered its stump are hundreds of delicate pink hydroids (*Tubularia crocea*) clustered in feathery colonies. Here and there among them peep forth the transparent solitary polyps of the white-armed sea anemone (*Sagartia leucolena*), while the larger brown sea-anemone (*Metridium marginatum*) expands its fringe-crowned disks on this and the neighboring piles, interspersed with coral red masses of the red-beard sponge (*Microciona prolifera*). Although these flower-like forms are relatively stationary and inactive, underneath their apparent peacefulness and beauty the struggle for existence goes on as relentlessly as among fierce free-swimming species, but with this difference, that their prey is invisible to our eyes. The waters in which they are immersed are swarming with myriads of microscopic creatures, while every polyp, with open rapacious mouth and extended stinging tentacles is but a trap to entangle and engulf them, and every sponge-colony with its million pores sucks in the nutritious draft of organisms which are the ultimate basis of food for all sea-life. In a word, sponges and polyps in spite of their size and wide diversity of form are but little above the simplest of all animals, the one-celled protozoa, and have developed as typically digestive organisms. Since their food is everywhere present, organs of locomotion are not needed to obtain it. Special senses and directive intelligence or instincts have not been definitely evolved, since the evolution of these powers always goes hand in hand with that of locomotor organs. It is true that certain polyps possess somewhat aimless and imperfect methods of locomotion such as the

[1] The field work, composition and effects for this group are the work of the author. The modeling and preparation was done by Mr. I. Matausch assisted by Mr. E. Müller, the glass-work by Mr. H. Müller, and the coloring by Messrs. S. Shimotori and I. Matausch, under the supervision of the author. Through the courtesy of the United States Fish Commission the laboratories and equipment of its Woods Hole station were put at the disposal of the Museum for the field work of this group

slow creeping movement of the sea anemones and the umbrella mode of propulsion peculiar to hydromedusæ and the true jellyfishes — a beautiful example of which (*Dactylometra quinquecirra*) is shown lazily swimming near the broken pile in the group. But the polyps as a whole may be considered as mere saclike stomachs, this specialization in digestion being their most striking advance, aside from their multicellular structure, over their protozoan progenitors. Yet there is good reason to believe that a polyp-like condition such as this is ancestral to the structure of all the higher and more complex groups of the Animal Kingdom.

Associated with the sponges and polyps upon the wharf piles are many other sedentary animals which like them feed upon the microörganisms of the sea. At first glance these seem to be of hardly higher organization than the polyps, but an examination of their structure at once shows them to be members of much higher groups in the scale of life. Examples of these are the edible bivalve mussels (*Mytilus edulis*) clustered thickly upon the piles. These animals are so closely adapted to an attached mode of life and a diet of microörganisms that the average observer, unacquainted with their affinities, would fail to recognize them as being included in the same great phylum (Mollusca) as the active and highly specialized squid, an example of which (*Loligo pealii*) is shown in the group swimming near the same pile. Again, closely encrusting the pile to the left are masses of coiled calcareous tubes, the homes of the tube-building worm (*Hydroides dianthus*) whose multicolored gill circlets are everywhere peeping forth from the tube-openings, giving their owners, to the superficial glance, a much closer resemblance to hydroids and small sea anemones than to highly specialized members of the annulate worm group to which they really belong.

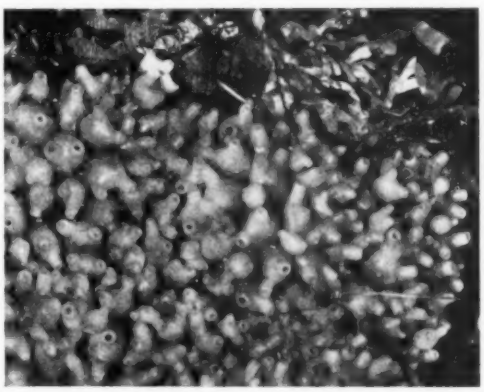


The squid (*Loligo pealii*), a carnivorous free swimming mollusk, propels itself by ejecting a stream of water. It has highly specialized eyes and a beak-like mouth surrounded by sucker-bearing tentacles

Finally, everywhere on the piles are various species of sea squirts or ascidians, singly and in colonies. These small saclike creatures each with

a projecting pair of tubes or "siphons," though apparently insignificant, are in reality highly interesting from an evolutionary standpoint. One species (*Molgula manhattensis*) is represented as growing in large yellow masses on the upper part of one of the piles. Some of the individuals of this species are marked with dark starlike colonies of another ascidian (*Botryllus gouldii*), which grow upon their surfaces. Here and there stand out the conspicuous masses of the pink "sea-pork" (*Amaroucium pellucidum*) a colonial ascidian whose minute individuals are perceptible as white dots forming irregular ringlike patterns on the colonial mass. On one pile a spreading white patch marks the position of a colony of the species *Leptoclinum albidum*, and here and there bits of delicate web-like net-work dotted with tiny green globules grow over mussels and sea-weed indicating the presence of the green ascidian (*Perophora viridis*). Some of the ascidians are more or less solitary like the brownish *Cynthia partita*, and still others (*Ciona tenella*) grow in clumps of several individuals, comparatively large in size. These have translucent yellowish bodies through which may be seen glimpses of the internal organs. The ascidians as a group possess a peculiar interest for biologists, since in spite of their humble appearance and

A typical ascidian, or sea-squirt (*Ciona tenella*). A food-bearing stream of sea-water enters and leaves the creature's sac-like translucent body by means of the two tubes or siphons



Large yellow masses of the sea-squirt *Molgula*, are often found on the submerged piles not far below the water surface

structure somewhat lower than that of a mollusk so far as complexity of organization is concerned, they are actually primitive members of the chordate group which includes the vertebrates and culminates in man. Their true relationship is shown by their life history according to the principle that an animal in its development tends to summarize certain of the changes that its ancestors have undergone in evolution: their young when first hatched are free-swimming, with tadpole-like tail, well-developed median eye, "brain" and central nervous system of the primitive chordate type, and the most striking indication of their affinity the larval notochord, or cartilaginous prototype of a backbone. As the animal approaches maturity however, it attaches itself to some stationary object, by means of sucking disks upon its head. It then undergoes a metamorphosis which involves the breaking up and degeneration of "brain," special sense organs and notochord while the nervous system is reduced to little more than a single ganglion. On the other hand the digestive system is rotated upon itself and together with the circulatory system and other organs, becomes adapted to the future sedentary life of the animal.

As in the case of the hydroid, the organization of the adult ascidian is chiefly that of a digestive and reproductive machine, but that it is of a much higher type than the polyp is evident from the relatively high specialization of its digestive apparatus.

Thus in an association of animals like that of the wharf piles, in which the various species are adapted to a sedentary existence and a diet of microörganisms, there may be three principal categories of forms,— first, those like the polyps which have reached the adaptation as the result of an evolution from still lower types; secondly, those like the tube-building serpulid worms and the bivalve mollusks, which have become greatly specialized to that mode of existence without much loss of complexity; and thirdly, those like the ascidians, which have undergone a considerable degeneration from a former more complex and highly organized type of structure.

Such an association also emphasizes the general tendency throughout the great groups of animals to take advantage of all the available sources of food supply in their environment. The microörganisms of the sea seem especially suitable as prey for the smaller and more primitive members of the animal kingdom like the sponges and polyps. Yet among the echinoderms, worms, crustaceans, mollusks, ascidians, chordates and even fishes (such as menhaden), there are certain forms in each group which have found it of advantage to share this great abundance of food. Thousands of microscopic creatures may swarm in a single drop of sea water; and in the course of time the species that feed upon them have become more and more perfectly adapted to this diet, often to the extent of undergoing profound modifications of structure and habits of life.

THE NEW WHARF-PILE GROUP

[Editorial comment and notes on the construction of the group]

FROM the standpoint of faithful reproduction of nature, there is no group in the American Museum of Natural History that surpasses the new marine group constructed under the supervision of Mr. Roy W. Miner. From the standpoint of general artistic effect, there is no very large number perhaps that compare with it. It is without doubt one of the most beautiful groups thus far constructed in this Museum, although differing so greatly in character from the three or four masterpiece mammal groups, the habitat bird groups and the frog group that comparison is difficult.

Its chief claim artistically, outside of what is inherent in the subject itself, lies in its handling of color and illumination. These have been so controlled as to produce distance in the scene above water and a depth and gradation of depth that give very unusual illusion under water. The splendid success of the group results in large part of course from the clever management of mechanical details of construction, and it may be said that there are few blemishes to be discovered by even the most critical eye. What this implies in an intelligent control of technical work can scarcely be appreciated except by the trained museum man, although a comparative study of groups in many museums will enforce the fact of the exceptional excellence to the most casual observer.

The following notes given by Mr. Miner concerning the mechanical work on the group will be enjoyed both by those who are directly interested in Museum constructive work and by the visitor who is merely curious as to how realistic effects have been produced:

The group is based on actual observations in the Woods Hole region, the life depicted being a faithful copy of that actually seen on the piles of wharves, especially on abandoned wharves whose piles have not been scraped. The abundance and beauty of this life are in no way exaggerated in the group and the life associations shown are possible anywhere in the Woods Hole region, although most of the direct studies were made at Vineyard Haven, six miles from Woods Hole village. In the field a miniature sketch model showing the composition of the future group was constructed. Then living specimens of the animals were removed from the piles and brought into the laboratory where they were kept alive in sea-water aquaria. Studies were made of them with and without the microscope, and they were sketched in color and photographed. The Museum photographer in New York was sent for to make the photographs for the transparency backgrounds, while dissections and enlarged drawings were prepared for use in constructing enlarged models for the accompanying synoptic series in the Darwin hall.

At the close of the summer season in the field, work on the group was continued in the Museum. First a wooden framework for the full-sized group was made by the

Museum carpenter, on which enlarged photographic prints were stretched as preliminary backgrounds to enable harmonizing the foreground construction with the natural perspective. The animal life in the group is represented by an assemblage of models except in the case of hard structures such as shells. The mussels on the piles are the actual specimens which were preserved in alcohol and afterward taken apart, the soft portions cleaned out and the shells reassembled with wax and cotton. The worm tubes are the natural dried specimens recolored. The starfish was also dried and prepared with a wax foundation, the tube feet being modeled in glass and inserted. The tubularian hydroids were all separately blown in glass and welded together in colonies, the sketches made in the field and the original alcoholic specimens being used as patterns. The color was sprayed on with the air brush, the finishing touches being made by hand in the usual manner. Some of the ascidians (for example, *Ciona tenella*) were blown in glass and their internal organs were modeled in the same material and inserted separately. Hundreds of tentacles for the sea anemones, cirri for the serpulid *Hydroides dianthus;* and even some of the seaweed are also the work of the glass-blower, but perhaps the best work in this line is the modeling of the jellyfish and the squid. The former is entirely of glass and is a masterpiece of the glass-blower's art, while the peculiar translucency of the squid's body could be attained by no other medium. The coloring of these two models by the Japanese artist is also a triumph of skill.

Much of the animal life however was modeled in such materials as wax and celluloid. The ascidian, *Molgula*, the colonies of the red beard sponge and the greater part of the sea anemones are of wax, while the delicate hydroid, *Bougainvillia*, and the green network colonies of *Perophora* are made of a combination of wax and German silver wire handled in most delicate fashion. One of the most creditable pieces of work, the accurate modeling and coloring of the wharf piles themselves, is the work of Mr. I. Matausch, who is also responsible for the technical skill in assembling and anchoring the hundreds of separate models and specimens in their final positions.

The coloring of the transparencies proved a problem peculiar to itself, involving the application of transparent oil colors, selected for their permanency under strong sunlight, to the surface of glass covered with a delicate photographic film (in the case of the transparencies represented as above the water line), and to the smooth surface of plate glass for the submarine background. This latter background is made up of five successive sheets of glass, each colored in such a manner that the daylight passing through the entire series gives the effect seen when looking horizontally through the waters of the ocean. The color effect for this part of the group is based on actual observation in the sea itself made with the help of a water glass and submerged mirror. Fishes, squid and a distant pile were painted on the successive plates of glass, thus giving them the lifelike effect of appearing suddenly from the gloom of the green sea depths. Since the whole group was placed in front of a window, the illumination is entirely that of the natural daylight, as transmitted through the various backgrounds. The cloud and sunshine and various outdoor light conditions in general thus produce their natural effects as they filter through the translucent backgrounds of the group.

MUSEUM NOTES

SINCE the last issue of the JOURNAL the following persons have been elected to membership in the Museum:

Benefactor, PROF. HENRY FAIRFIELD OSBORN;

Associate Benefactor, MR. A. D. JUILLIARD;

Fellow, MR. FREDERIC C. WALCOTT;

Honorary Fellows, CAPTAIN ROALD AMUNDSEN, ADMIRAL ROBERT E. PEARY;

Life Members, REV. ARTHUR HUNTINGTON ALLEN, MESSRS. WILLIAM F. BELLER, WARREN DELANO, D. K. ESTE FISHER, JR., FRANCIS P. GARVAN, CHARLES E. HANAMAN, CHARLES B. ISHAM, OGDEN L. MILLS, EDMUND PENFOLD, JOHN J. RIKER, ARCHIBALD D. RUSSELL, HERBERT F. SCHWARZ, ALBERT JAMES SHELDON, HOWARD CASWELL SMITH, WILLIAM BOYCE THOMPSON;

Sustaining Members, MRS. HELEN HALL VAIL and MESSRS. JOHN F. HARRIS and FREDERICK STURGES;

Annual Members, MRS. J. SCOTT ANDERSON, MRS. ELMER E. BLACK, MRS. H. L. BLUM, MRS. JESSIE B. CAMERON, MRS. REBECCA McM. COLFELT, MRS. WILLIAM D. GAILLARD, MRS. W. PIERSON HAMILTON, MRS. JOHN HAYS HAMMOND, MRS. ALFRED JARETZKI, MRS. ADAM LEROY JONES, MRS. AMANDA F. LAUTERBACH, MRS. CASIMIR DER. MOORE, MRS. BRADFORD NORMAN, MRS. W. A. PAYNE, MRS. CHARLES G. STODDARD, MRS. GEORGE F. VIETOR, MISS ALICE M. DAVISON, MISS CAROLINE B. DOW, MISS FLORENCE WIER GIBSON, MISS SOPHIE HOFFMAN McLANE, MISS BERTHA V. MERRICK, MISS MARJORIE T. SINCLAIR, MISS ANNIE STONE, DR. WILLIAM B. DUNNING, DR. HOWARD LILIENTHAL, DR. ARNOLD STURMDORF, and MESSRS. J. S. ALEXANDER, A. K. ALFORD, W. H. ANDREWS, HUGH POTTER BAKER, HERBERT BARBER, THOMAS HENRY BAUCHLE, JR., ANDREW A. BENTON, H. HENRY BERTRAM, ARTHUR C. BLAGDEN, HUGHES BRYANT, EDWARD BURNS, WILLIAM CARPENDER, PERCY M. CHANDLER, O. H. CHENEY, GEORGE A. CRIDER, WILLIAM NELSON DAVEY, JOHNSTON DE FOREST, DAVID DOWS, FREDERICK L. ELDRIDGE, BENJAMIN F. ELGAR, 2d, R. K. FORSYTH, HUGH F. FOX, DOUGLAS W. FRANCHOT, JOSEPH FRANK, FRANK B. GILBRETH, W. S. GORDON, J. S. HALLE, CHARLES HATHAWAY, SAMUEL B. HAWLEY, W. DEF. HAYNES, EDGAR C. HEBBARD, JOHN B. HENDERSON, JR., SIMON HESS, GRANGER A. HOLLISTER, E. COE KERR, LUCIAN S. KIRTLAND, EDWARD H. KRUSE, FREDERIC S. LEE, LOUIS S. LEVY, FRANK J. LOESCH, C. A. LUDLUM, ADAM K. LUKE, C. N. MASON, JOHN C. McCALL, GEORGE R. McCLELLAN, THOMAS P. McKENNA, FRANCIS W. McMILLAN, PAUL B. MORGAN, H. D. NESSLER, GEORGE P. PUTNAM, JAMES RASCOVAR, J. D. ROCKWELL, AUGUSTUS J. ROLLE, WILLIAM P. ROOME, P. D. SAKLATVALA, ISADORE SAKS, LOUIS J. SCHILLER, EDWARD M. SCUDDER, WILLIAM E. SEYMOUR, WILLIAM G. SHAILER, JOHN SINNOTT, JAMES A. SWAN, MARCUS STRAUS, WILLIAM R. STROBEL, FRANK SUTTON, AUGUSTUS PORTER THOMPSON, CHARLES THORLEY, ARTHUR TURNBULL, OWEN WARD, H. WALTER WEBB, ARTHUR WILLIAM WEIL, JOHN C. WELWOOD, E. G. WHITAKER, GEORGE F. WILLETT, ALEXANDER S. WILLIAMS and JOSEPH WILLIAMS.

THE forty-fourth annual meeting of the trustees of the American Museum of Natural History was held on Monday, February 3, 1913, at the residence of Mr. Adrian Iselin, Jr. The following were elected officers for the coming year: president,

Henry Fairfield Osborn; first vice-president, Cleveland H. Dodge; second vice-president, J. Pierpont Morgan, Jr.; treasurer, Charles Lanier; secretary, Adrian Iselin, Jr. who succeeds Archer M. Huntington.

Mr. Frederick F. Brewster was elected as a new member of the board of trustees and the following members of the board were reëlected: Mr. Albert S. Bickmore, Mr. Adrian Iselin, Jr., Mr. Thomas deWitt Cuyler, Mr. Ogden Mills and Mr. Madison Grant.

The executive staff of the Museum was reappointed as follows: director, Frederic A. Lucas; assistant secretary, George H. Sherwood; assistant treasurer, the United States Trust Company of New York.

THE American Museum has adopted a pension plan which will go into effect on March first. It is a departure in this country, the first instance recorded of a museum of sciences originating a pension system for the benefit of its employees. The idea was suggested to President Osborn by an investigation of the pension plans in operation in Europe. The committee which acted in the matter included the following trustees: Mr. Felix M. Warburg, Mr. Adrian Iselin, Jr., and Mr. Anson W. Hard.

In brief the plan is a contributory system, three per cent of the annual salaries being paid to the fund by the employees and a like amount by the corporation. The plan provides:

1. Pensions — Six classes of pensions according to length of service and age, the pensions varying from twenty-five to fifty per cent of the average salary of the last three years.
2. Health Insurance — Gratuity to the employee in case he is totally disabled through illness, or his position is abolished.
3. Life Insurance — Gratuity to a beneficiary, in the event of the death of the employee, and under certain conditions in the event of the death of a pensioner.
4. For the return of the employee's contribution with simple interest at three per cent in case the employee leaves the service of the Museum before he is eligible for a pension.

AT the annual meeting of the board of trustees, Mr. A. D. Juilliard was made associate benefactor of the American Museum in recognition of his generous contributions and continued activity in matters that tend toward the growth of the institution.

THE Jesup lectures on "Heredity and Sex" by Dr. Thomas H. Morgan, professor of experimental zoölogy in Columbia University, began in the auditorium of the American Museum, February 5 and will continue to be given on Wednesday evenings until March 26. The subjects of the series are as follows:

February 5 — "The Evolution of Sex"
February 12 — "The Mechanism of Sex Determination"
February 19 — "The Mendelian Principles of Heredity and their Bearing on Sex"
February 26 — "Secondary Sexual Characters and their Relation to Darwin's Theory of Sexual Selection"
March 5 — "The Effects of Castration and of Grafting on the Secondary Sexual Characters"
March 12 — "Parthenogenesis and Sex"
March 19 — "Inbreeding and Fertility"
March 26 — "Special Cases of Sex Inheritance"

MR. VILHJÁLMUR STEFÁNSSON will sail early in March for Europe where he will purchase a part of the scientific equipment for the new Arctic expedition. He will address the Royal Geographical Society while in London and later attend the International Geographical Congress at Rome as delegate of the National Geographic Society.

A RECEPTION at the Museum on the evening of February 26 marked the opening of the exhibition of collections, paintings and photographs illustrating the daily life and ceremonies of the Indians of the Southwest. In this exhibition the following complete collections are placed on view for the first time: The Collis P. and Archer M. Huntington collections; the Anson W. Hard serape collection; the J. P. Morgan Navajo collection; the Mrs. Russell Sage blanket collection; the James Douglas basket collection; selected specimens from the Hyde archæological collections and the Lumholtz Mexican collections.

Among the pictorial exhibits are a series from the Morgan collection of Curtis prints and one from the Museum collection of Karl Moon photographs. The late Louis Akin is represented by paintings loaned by Messrs. C. L. Le Fevre, G. H. Frommann, Goelet Gallatin and W. H. Simpson. The following artists have loaned examples of their work: Ernest L. Blumenschein, R. W. Chanler, Kate Cory, E. Irving Couse, E. W. Deming, Howard McCormick, Bert G. Phillips and Mahonri M. Young. The exhibition will remain open to the public until March 26.

THE Museum has announced to the principals and teachers of the New York City schools a series of lectures grouped in three courses in accordance with the new method adopted in the fall. The lectures will be given by the members of the Museum staff and will specialize on the history and geography of the United States and New York City. They will be illustrated with lantern slides and moving pictures.

THE Instituts Solvay, Bruxelles, in its last *Sociological Bulletin* published extracts and translations in French of Dr. Wissler's recent Museum publication on the "Ceremonial Bundles of the Blackfoot Indians." Two full pages of illustrations and some text figures were also reproduced. The parts of the paper dealing with the social aspects of certain religious ceremonies were regarded as important sociological contributions.

A series of natural history picture stories has been arranged for the children of members of the Museum. These are designed primarily for entertainment, yet through the pictures taken from life hope to teach something of the habits of wild creatures and the relationship and interdependence of all life. They will be given on Saturday mornings in the auditorium of the Museum and will be illustrated with moving pictures. The stories will be as follows:

March 1 — "Jungle Scenes in Africa, India and Borneo," by CHERRY KEARTON
March 8 — "Wild Animal Neighbors," by ERNEST HAROLD BAYNES
March 15 — "A Monkey on Safari," by CARL E. AKELEY
March 22 — "*Poonkong* and his People," by PLINY E. GODDARD
March 29 — "Our Friends the Trees," by GEORGE H. SHERWOOD

A SHIPMENT of birds and mammals has been received from Mr. W. B. Richardson, who has been collecting for the Museum in Ecuador.

DR. W. S. RAINSFORD, in charge of the Museum's third African expedition, reports that he has been successful in securing a large series of specimens, including the black rhinoceros which was one of the special objects of the expedition.

DR. R. M. ANDERSON was appointed assistant in the department of mammalogy at the February meeting of the board of trustees. Dr. Anderson will accompany the Stefánsson expedition to the Arctic as zoölogist and second in command.

MR. J. H. O'NEIL, assistant in the department of public health, has resigned to accept an appointment as sanitary engineer of the State Board of Health of Louisiana. His place is taken by Mr. D. Greenberg, a graduate of the College of the City of New York.

DR. W. D. MATTHEW of the department of vertebrate palæontology left on February 3 for a month's trip to Los Angeles, California, where he is to study the famous asphaltum pools of Rancho La Brea in connection with a group now under preparation in the department. He hopes also to effect exchanges with California institutions which have done excavating at La Brea ranch, whereby the Museum may acquire additional specimens of the wonderfully preserved Pleistocene fossils which these asphaltum pools contain. The Museum's present collection from these deposits, obtained through exchange, includes skeletons of the saber-toothed tiger and an extinct species of wolf and a skull of the ground sloth. Dr. Matthew is taking advantage of the opportunity to visit en route the museums of Pittsburgh, Chicago, Lincoln, Laramie and San Francisco.

DR. C-E. A. WINSLOW has recently been elected president of the Society of American Bacteriologists.

DR. R. W. SHUFELDT of Washington, who is well known as one of the few authorities upon fossil birds in this country, has completed a revision of the Pleistocene fossil birds in the American Museum collections and is now engaged upon a study of the Tertiary bird specimens. Fossil birds are extremely rare and Dr. Shufeldt's contributions will add materially to one of the least known chapters of the history of life. Among the specimens in his hands for study are a few fragments of a gigantic bird from the Lower Eocene equalling in size the extinct moa of New Zealand. This specimen was found by the Museum expedition in Wyoming last summer, and some more or less imaginative notices of it have appeared in the daily papers. The full results of Dr. Shufeldt's studies will appear in the *American Museum Bulletin*.

DURING the past month there have been a number of additions to the collections of the department of mammalogy. Thirty-five of the great fruit bats from the Philippine Islands with complete accessory material for a group have been received. These bats are found in rookeries consisting at times of as many as fifteen or twenty thousand individuals. The collections made by Dr. Rudolph M. Anderson in the Arctic have arrived at the Museum. Among them is the magnificent series of barren ground bear which has already been noted in the JOURNAL. Also the northern Korea collections of mammals made by Mr. Roy C. Andrews, have arrived in New York safely after what proved to be an adventurous voyage from the Orient.

MR. CLYDE G. FISHER of Johns Hopkins University, has been appointed assistant curator in the department of public education, the appointment to take effect on May 1, 1913.

ON Saturday afternoon, March 8, the Museum will tender a reception to the public school teachers who give their services for the after-school athletics of the girls' branches of the Public Schools Athletic League.

Scientific Staff

DIRECTOR

FREDERIC A. LUCAS, Sc.D.

GEOLOGY AND INVERTEBRATE PALÆONTOLOGY

EDMUND OTIS HOVEY, Ph.D., Curator
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